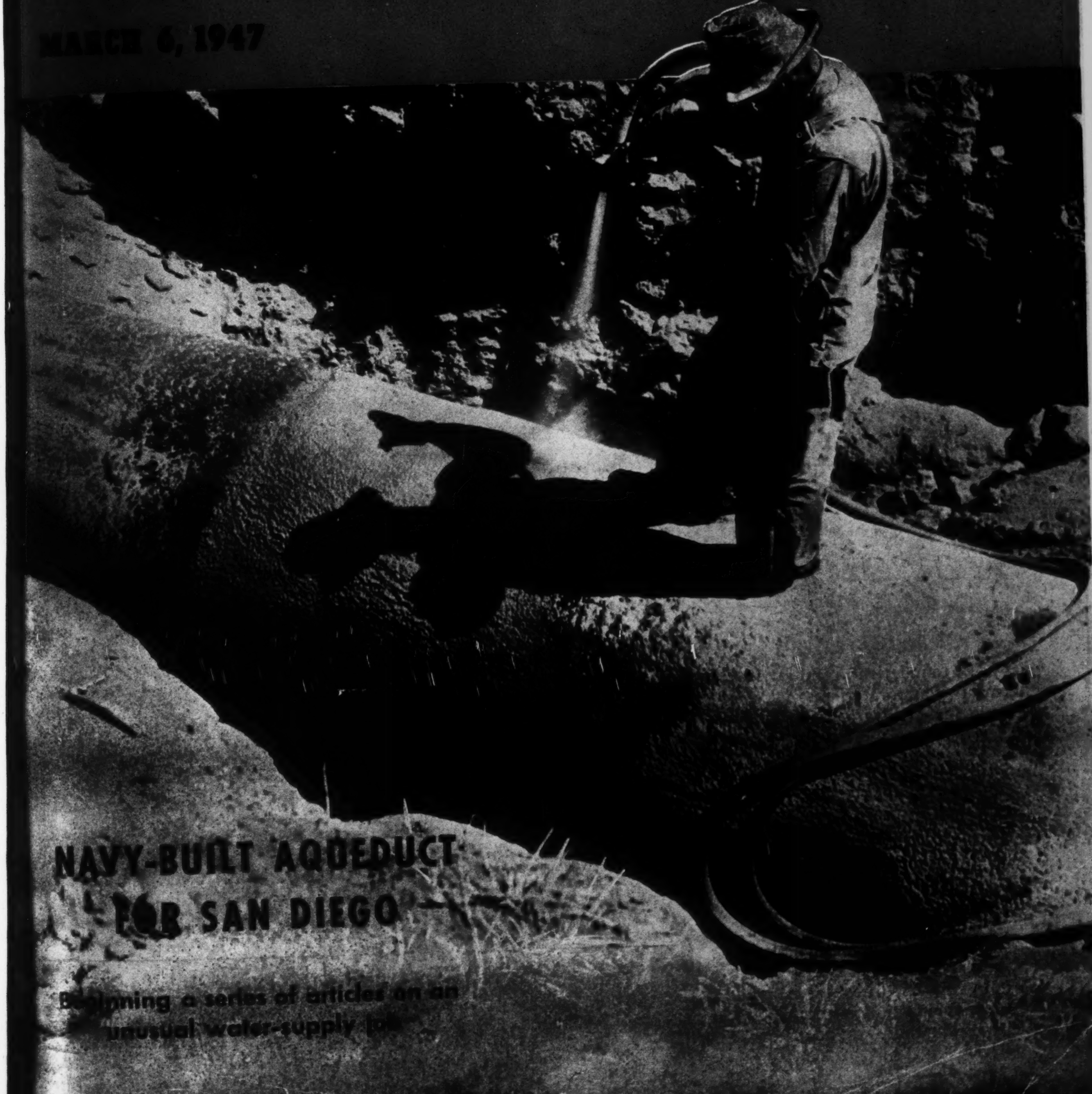
MAR 10 1947

ENGINEERING NEWS-RECORD

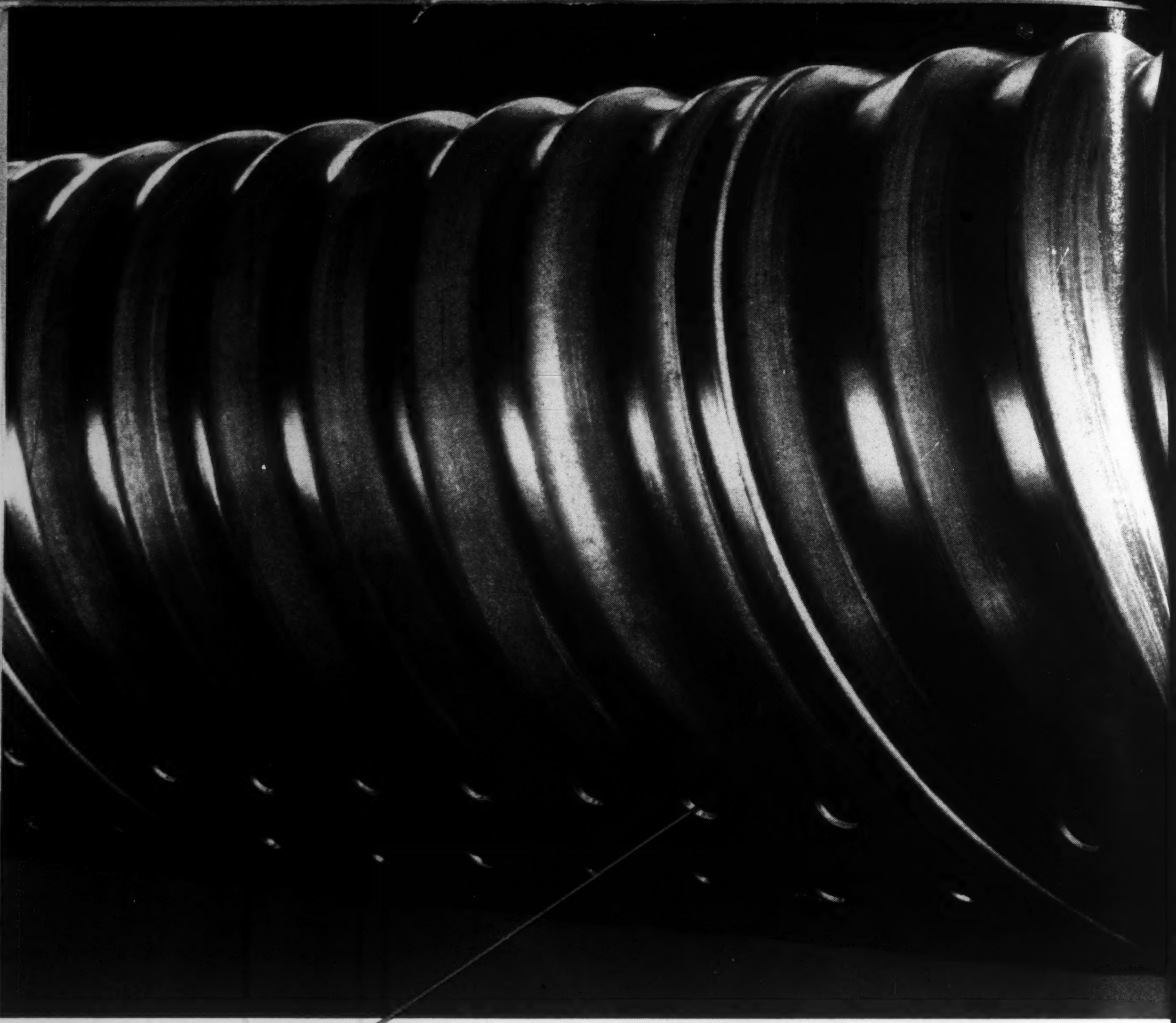
A McGRAW-HILL PUBLICATION

MARCH 6, 1947



NAVY-BUILT AQUEDUCT FOR SAN DIEGO

Beginning a series of articles on an unusual water-supply job



A hole is the world's best stabilizer

Jelly-like foundations, resulting from harmful groundwater, mean lots of trouble for highways, railways and airports. Surface failures and high maintenance expense are sure to follow.

To answer this problem ARMCO Engineers developed Hel-Cor Pipe and perforated it. Scientifically placed holes collect unwanted water, which is drained off along the pipe invert and subgrades become dry and stable. Made on automatic machines, this pipe meets all the needs of a first-class subdrainage system. It is low in cost, easy to handle, durable, and has ample corrugated strength to withstand shifting soils, frost action or the impact and vibration of heavy loads.

This is only one of the many products pioneered by ARMCO during the past 40 years to meet specific drainage and construction needs. ARMCO men have cooperated with engineers and contractors to whip erosion and corrosion; speed installation time; provide greater safety and economy at every turn.

These are some of the reasons why it will be worth your while to bring your problems to ARMCO. Here you will find a complete range of engineered products and convenient, authoritative data in every field—highway, railway, airport, municipal or industrial. If your problem is unusual, you'll want to talk it over with one of our specialized engineers.

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Structural Plate Pipe and Arches ★ Corrugated Metal Pipe ★ Welded Steel P
FLEX-BEAM Guardrail ★ Water Control Gates ★ Retaining Walls ★ STEELOX Buildi
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ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewerage, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Airports, Irrigation, Canals, Tunnels, Railroads

Volume 138 • Number 10

March 6, 1947

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WESTERN FOUNDATIONS for Powerhouses

Main Powerhouse
UNION POWER COMPANY
Venice, Ill.

WESTERN Button Bottom Piles* solved one of the toughest foundation problems when they matched their strength against mighty *Old Man River.*

Stone & Webster Engineering Corporation, Engineers and Architects

UNION POWER COMPANY'S main Powerhouse posed an arresting engineering problem — 3200 pounds per square foot of hydrostatic uplift on the floor of the building. Here it wasn't a question of just holding the structure UP . . . the foundations also had to hold it DOWN.

WESTERN'S SOLUTION was Button Bottom Piles* combined with steel pipe piles. To meet the uplift poser, the Button Bottom Piles were designed to take tension by internal reinforcement connecting with a hook cast into the button. (See drawing.)

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AMONG OTHER UPLIFT JOBS BY WESTERN is the biggest waterless gas holder in the world . . . built for Peoples Gas Light & Coke Company in Chicago, Illinois with a capacity of 20,000,000 cu. ft.

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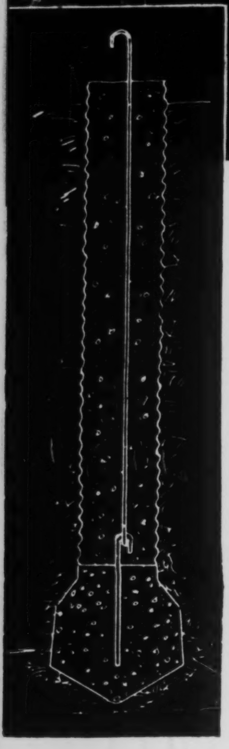

FOUNDATIONS FOR

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Construction Trends

Construction's Position in the Wage Scale

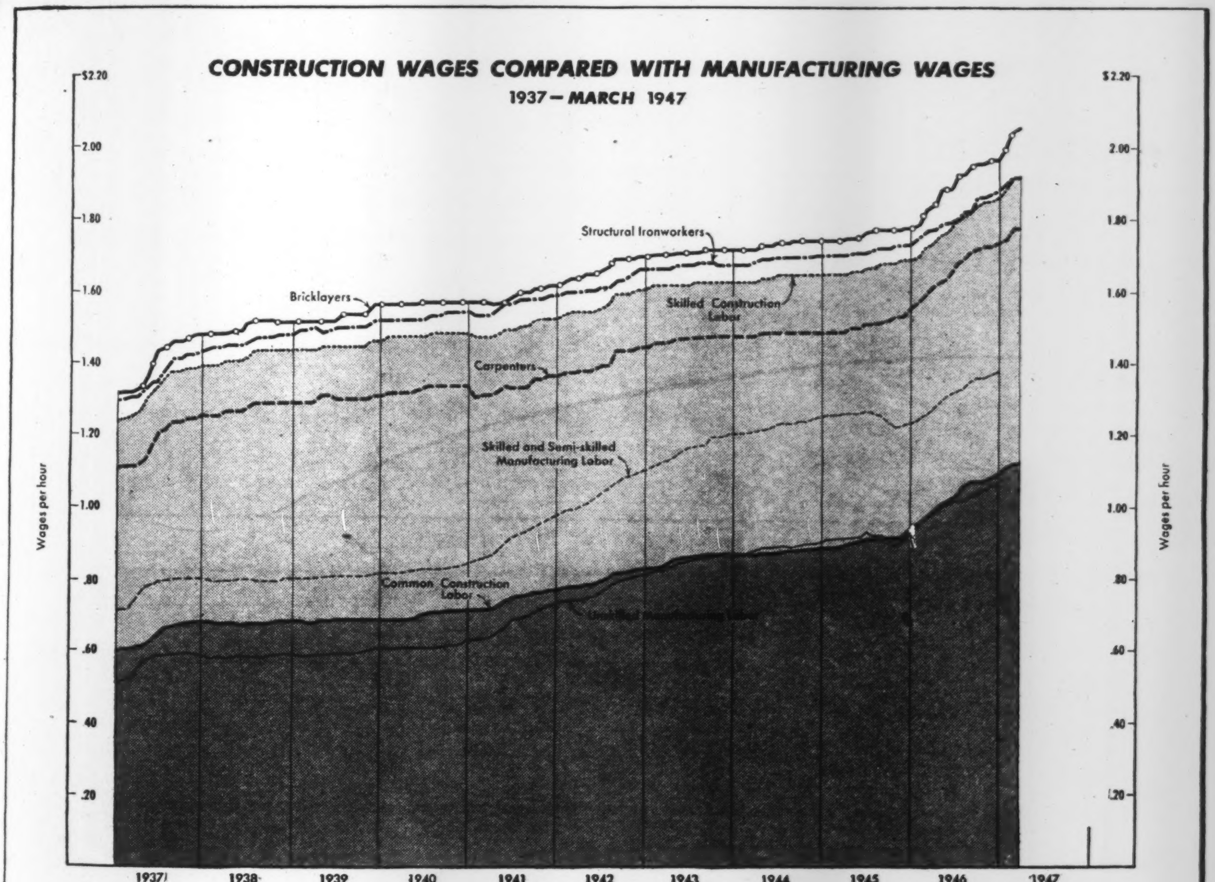
From January 1937 through December 1946, skilled construction hourly wages rose 52.5%, as recorded by *Engineering News-Record*, while skilled and semi-skilled manufacturing wages, recorded by the National Industrial Conference Board, jumped 91.7%. In this period, common construction hourly wages increased 81.7%, and unskilled manufacturing wages gained 103.8%.

Prior to January 1941, construction and manufacturing wages retained their approximate relative positions. January 1941 skilled construction wages were 20.5% higher than January 1937 wages, while skilled and semi-skilled manufacturing wages gained 18.1% in this period. Common construction wages gained 18.3%, compared to a rise of 21.2% in unskilled manufacturing wages.

From January 1941 to the end of the war, construction workers lost much of the pay increment usually accorded them as compensation for irregularity of employment. In this period, skilled construction hourly wages rose only 13.6%, while skilled and semi-skilled manufacturing wages increased 48.2%. Common construction labor received hourly wage gains of 29.6%, while unskilled manufacturing workers realized wage gains of 46.0%.

Following the war, construction wages took a sharp upward turn. By the end of 1946, skilled construction wages had risen 11.4% over August 1945, while skilled and semi-skilled manufacturing wages had gained only 9.5%. Similarly, common construction wages rose 18.5%, compared to a gain of 15.2% for unskilled manufacturing wages.

Manufacturing wage rates are not available for comparison in 1947, but March 1947 skilled construction wages have shown a gain of 3.2% over December 1946 wages, while common construction wages have risen 2.8%. Recruiting of construction labor will become more easy as the industry tends to regain its normal relative position in the peacetime wage scale.

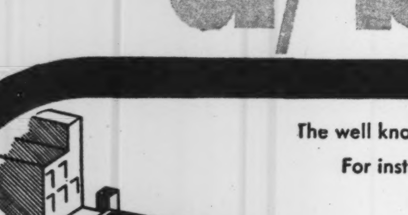

CONSTRUCTION WAGES COMPARED WITH MANUFACTURING WAGES
1937 — MARCH 1947

Manufacturing Wage Statistics by NICB
Construction Wage Statistics by Engineering News-Record

Chart by ENR Business News Dept.

a/b=c/d

CONSIDER THE RULE OF 3 IN YOUR PLANNING



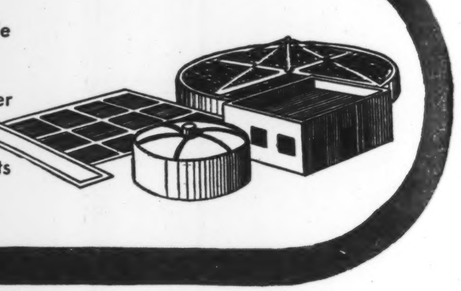
The well known rule of three applies in chlorination as well as it does in mathematics.

For instance, water plants need —

1. *Prechlorination* for improved coagulation, color removal, algal control, etc.
2. *Plant chlorination* for increased filter runs, sterilization, manganese removal and increased plant efficiency.
3. *Post chlorination* for taste and odor control and elimination of gas-formers throughout the system.

Sewage plants, too, need —

1. *Interceptor chlorination* for odor control, reduction of hydrogen sulfide damage to concrete structures and prevention of septicity.
2. *Plant chlorination* for odor control, prevention of sludge bulking, digester super-natant treatment, prevention of filter ponding, etc.
3. *Effluent chlorination* for sterilization to meet stream pollution requirements and prevent damage to recreation areas.



And Industrial plants need —

1. *Process Water chlorination* for quality control and elimination of spoilage losses.
2. *Cooling Water chlorination* for increased heat exchanger efficiency and reduced labor costs.
3. *Waste Water chlorination* to facilitate disposal of objectionable mill-waste products.

Thus, in your planning for any plant, consider the three time use of chlorination for a more flexible, better equipped plant with the low cost "room for expansion" that only chlorination can give.

A wealth of new information on the uses of chlorination is yours for the asking and any W & T Chlorination Specialist will be glad to assist you on your chlorination problems. Call on them freely.

S-2

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New Construction Volume in February

Civil engineering construction volume in continental United States totals $356,491,000 for February, an average of $89,123,000 for each of the four weeks of the month. This average is 3 percent above the average for January, and is 44 percent above the average of February, 1946, according to *Engineering News-Record.*

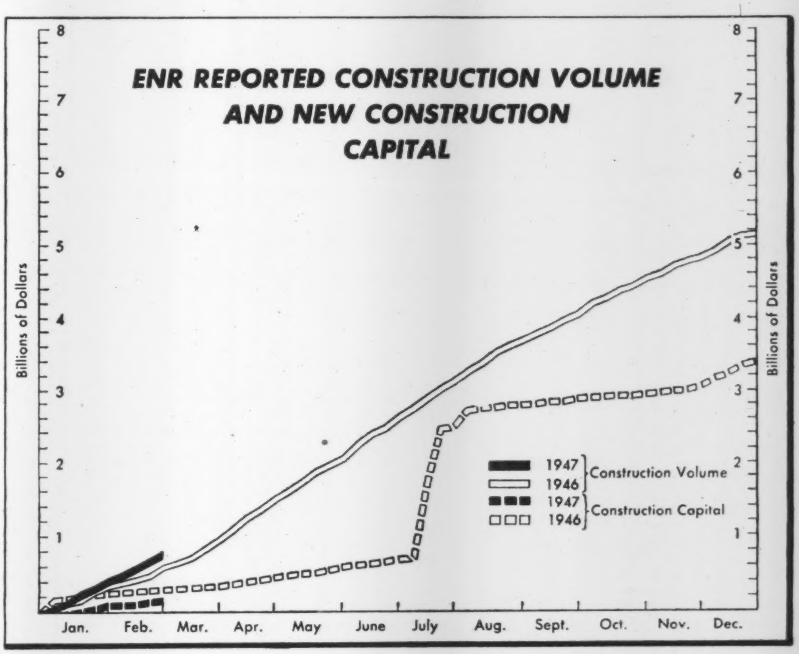
Private construction for February on a weekly average basis is 2 percent above last month, and 36 percent greater than February, 1946. Public construction is 6 percent above last month and 61 percent above last February. State and municipal construction is 15 percent above last month, and 87 percent above the average for February, 1946. Federal construction, down 17 percent from last month, is 9 percent above February, 1946.

Weekly averages in the various classes of construction for February, 1947 compared with January, 1947, show gains in public bridges of 70 percent; sewerage, 26 percent; earthwork and drainage, 90 percent; public unclassified, 35 percent; private unclassified, 187 percent; and highways, 21 percent; losses in waterworks, 65 percent; public buildings, 26 percent; industrial buildings, 8 percent; and commercial buildings, 8 percent.

Geographically, four sections showed gains in February over January — New England, 66 percent; South, 12 percent; Middle West, 21 percent; and West of the Mississippi, 41 percent. Middle Atlantic dropped 20 percent below January; and Far West, 18 percent.

Four sections made gains in February over February, 1946—Middle Atlantic, 105 percent; South, 133 percent; West of the Mississippi, 29 percent; and Far West, 22 percent. New England dropped 5 percent below last year, and Middle West, 5 percent.

New capital for construction purposes for the four weeks of February totals $74,592,000, a weekly average of $18,648,000, 14 percent below the January average, and 89 percent above the February, 1946 average.



ENGINEERING CONSTRUCTION CONTRACTS REPORTED TO ENGINEERING NEWS-RECORD—FEBRUARY, 1947

Engineering News-Record *reports continental U. S. Construction projects of the following minimum costs —Waterworks, excavation, drainage and irrigation,* $22,500; *other public works,* $40,000; *industrial buildings,* $55,000; *other buildings,* $205,000
Four Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	United States: February 1947	United States: Two Months 1947	United States: Two Months 1946	Canada
Public Works										
Waterworks	227	423	383	695	2,182	300	**4,210**	**19,068**	9,602	838
Sewerage	40	408	789	1,036	4,209	1,540	**8,022**	**15,956**	5,660	296
Bridges, public	3,278	1,536	3,359	1,344	1,345	2,191	**13,053**	**22,626**	15,214	190
Earthwork and waterways	85	818	10,745	571	640	360	**13,219**	**21,913**	36,909	684
Streets and roads	....	4,841	13,156	2,019	12,606	4,697	**37,319**	**75,884**	64,908	554
Buildings, public	532	10,016	4,813	2,241	10,831	2,022	**30,455**	**81,897**	44,916	3,095
Unclassified, public	1,473	2,422	1,568	8,954	3,425	3,804	**21,646**	**41,635**	13,000	1,145
Total public	**5,635**	**20,464**	**34,813**	**16,860**	**35,238**	**14,914**	**127,924**	**278,979**	**190,209**	**6,802**
Federal government (included in above classifications)	246	1,078	13,415	725	8,095	5,198	**28,757**	**71,945**	66,646	....
Private										
Bridges, private	....	....	....	....	....	....	....	....	1,065	....
Industrial buildings	8,934	17,271	5,013	6,633	15,800	3,578	**57,229**	**134,909**	180,577	27,653
Commercial buildings	3,722	50,177	25,001	17,840	5,665	35,754	**138,159**	**325,926**	195,380	2,510
Unclassified, private	....	135	543	851	27,356	4,294	**33,179**	**47,647**	29,071	1,380
Total private	**12,656**	**67,583**	**30,557**	**25,324**	**48,821**	**43,626**	**228,567**	**508,482**	**406,093**	**31,543**
Total Engineering Construction:										
February, 1947 — 4 weeks	**18,291**	**88,047**	**65,370**	**42,184**	**84,059**	**58,540**	**356,491**	....	....	**38,345**
January, 1947 — 5 weeks	13,753	137,140	72,968	43,754	74,656	88,699	**430,970**	....	....	37,925
February, 1946 — 4 weeks	19,255	42,973	28,079	44,515	65,131	48,072	**248,025**	....	....	29,789
Two Months — 1947	**32,044**	**225,187**	**138,338**	**85,938**	**158,715**	**147,239**	....	**787,461**	....	**76,270**
Two Months — 1946	56,345	106,881	70,542	81,258	127,051	154,225	....	....	**596,302**	**54,052**

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Convenient Ryerson Steel Service

Twelve strategically located Ryerson plants bring quick service on steel from stock within easy reach of contractors and builders the country over.

Structurals, plates, reinforcing bars and accessories, wire mesh, steel spirals, threaded rod, alloys, stainless—every steel product obtainable under present conditions is ready for prompt shipment from the Ryerson plant nearby.

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If you are ordering for a distant job, here's another advantage of Ryerson service. You can deal with your local Ryerson plant and have the steel shipped from the Ryerson plant nearest the job.

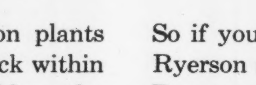
So if you are planning for the future include Ryerson steel service in your plans. And call Ryerson for today's construction requirements. In the face of present shortages, our stocks are not always complete but we will do everything in our power to work with you.

Joseph T. Ryerson & Son, Inc. Steel-Service Plants at: Chicago, Milwaukee, Detroit, St. Louis, Cincinnati, Cleveland, Pittsburgh, Philadelphia, Buffalo, New York, Boston, Los Angeles.

HI-BOND* RE-BARS

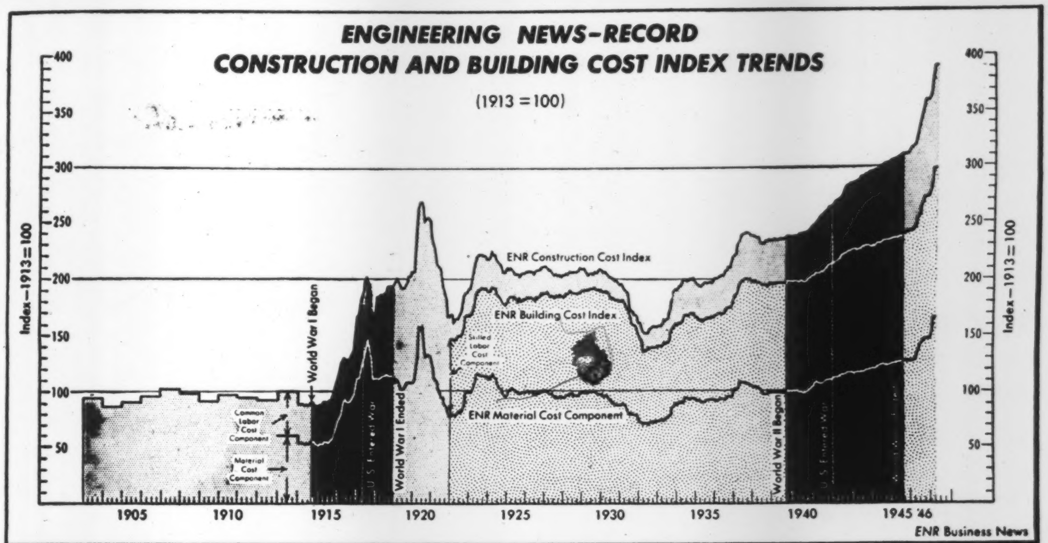
Scientific design provides Hi-Bond reinforcing bars with greater mechanical grip. Gives increased bonding value. Reduces cracking of concrete. Ryerson plants in Chicago, Detroit and Cincinnati regularly stock Hi-Bond rounds in sizes from ⅜ to 1.53 inches (1-¼″ square equivalent). Today, all sizes are not always in stock but we urge you to investigate the many advantages of Hi-Bond. Bulletin on request.

*REG. U.S. PAT. OFF.



RYERSON STEEL

MARCH CONSTRUCTION BUSINESS REPORT


ENGINEERING NEWS-RECORD
CONSTRUCTION AND BUILDING COST INDEX TRENDS
(1913 = 100)

ENR Business News

ENR CONSTRUCTION VOLUME AND NEW PRODUCTIVE CAPITAL

Thousands of Dollars (,000 omitted)	February 1946 (4 wk.)	February 1947 (4 wk.)	% Change	Two Months 1946 (9 wk.)	Two Months 1947 (9 wk.)	% Change
Total U. S. Construction	$248,025	$356,491	+44	$596,302	$787,461	+32
Private Construction	168,630	210,567	+25	406,093	508,482	+25
Public Construction	79,395	127,924	+61	190,209	278,979	+47
Federal	26,473	28,757	+9	66,646	71,945	+8
E N R Construction Volume Index, 1913 = 100	167	197	+18	178	196	+10
Total New Productive Capital	39,536	74,592	+89	143,333	183,005	+28
Private Investment	39,536	74,592	+89	143,333	183,005	+28
Federal (non-federal work)	....	....	......	....	....	......
Federal (federal work)	....	....	......	158,320	....	......

CONSTRUCTION COST....WAGE RATES....MATERIAL PRICES

1913 = 100	March 1946	March 1947	% Change	Change February to March 1946 Feb.	1946 Mar.	%	1947 Feb.	1947 Mar.	%
E N R Constr. Cost Index†	323.83	391.93	+21.03	319.52	323.83	+1.35	390.76	391.93	+0.30
E N R Building Cost Index†	245.41	298.82	+21.76	243.94	245.41	+0.60	297.38	298.82	+0.48

† *Does not reflect increased costs due to overtime, lower labor efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

	March 1946	March 1947	% Change	1946 Feb.	1946 Mar.	%	1947 Feb.	1947 Mar.	%
Common Labor	$0.988	$1.123	+13.66	$0.968	$0.988	+2.1	$1.123	$1.123	0.0
Skilled Labor (Av. 3 Trades)	1.743	1.923	+10.33	1.726	1.743	+1.0	1.919	1.923	+0.21
Bricklayers	1.839	2.061	+12.07	1.823	1.839	+1.0	2.047	2.061	+0.68
Structural Ironworkers	1.771	1.924	+8.64	1.764	1.771	+0.4	1.924	1.924	0.0
Carpenters	1.618	1.779	+9.95	1.592	1.618	+1.6	1.779	1.779	0.0
Cement, per barrel	2.74	3.483	+27.12	2.74	2.74	0.0	3.366	3.483	+3.48
Reinforcing Steel, cwt.	2.79	3.570	+27.96	2.79	2.79	0.0	3.475	3.570	+2.73
Structutal Steel, base	2.10	2.50	+19.05	2.10	2.10	0.0	2.50	2.50	0.0
Sand, per ton	1.25	1.730	+38.40	1.25	1.25	0.0	1.672	1.730	+3.47
Lumber, 2x4 Fir, per M ft.	55.66	82.505	+48.23	54.99	55.66	+1.2	80.406	82.505	+2.61
Lumber, 2x4 Pine, per M ft.	54.46	81.132	+48.98	54.55	54.46	−0.1	81.238	81.132	−0.13
Common brick, per M	20.33	22.829	+12.29	20.00	20.33	+1.6	21.868*	22.829	+4.39
Ready-mixed concrete, c.y.	7.64	8.842	+15.73	7.73	7.64	−1.2	8.649	8.842	+2.23
Struct. clay tile, 3x12x12	90.23	107.293	+18.91	88.49	90.23	+2.0	107.293	107.293	0.0

* Revised.

MATERIAL SHIPMENTS . . . . BUILDING PERMITS

	February 1946	February 1947	% Change	January 1947	% Change January to February
Steel (% operating Capacity) A.I.S.I.	21.2	93.7	+342	91.4	+3

	December 1945	December 1946	% Change	Twelve Months 1945	Twelve Months 1946	% Change
Cement, thous. bbl. U.S.B. of Mines	6,112	11,494	+88	106,400	169,336	+59

	January 1946	January 1947	% Change	Twelve Months 1945	Twelve Months 1946	% Change
Fabricated Structural Steel, tons, A.I.S.C.	108,048	126,868	+17	797,441	1,551,607	+95
Building Permits, 215 Cities, Dun & Bradstreet (,000 Omitted)	$204,052	$156,531	−23	$1,258,020	$2.556,380	+103

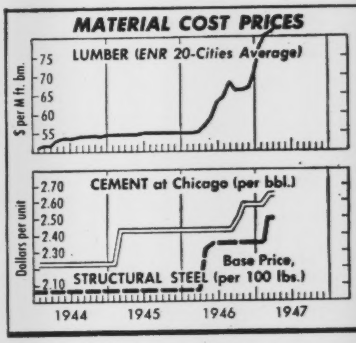
COST OF LIVING INDEX . . . . EMPLOYMENT

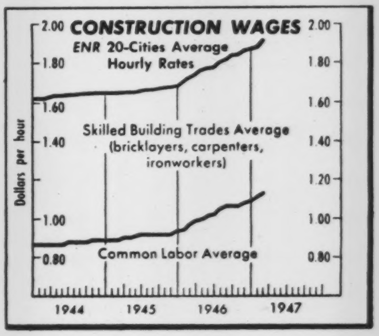
	January 1946	January 1947	% Change	December 1946	% Change December to January
Consumers' Price Index, B L S	129.9	153.1	+17.9	153.3	−0.1
Rent (Housing) Index, B L S	108.3	108.8	+0.5	108.8	0.0

	February 1946	February 1947	% Change	January 1947	% Change January to February
Const. Employment (est.), thous., B L S	1,406	1,521	+8.2	1,642	−7.4
Private Const. Employ. (est.), thous., B L S	1,226	1,250	+2.0	1,326	−5.7

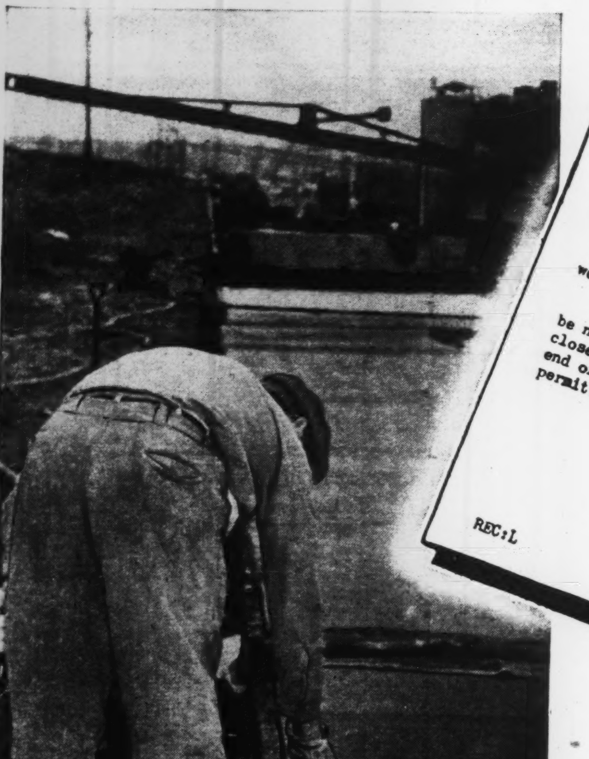
ENR INDEX NUMBERS

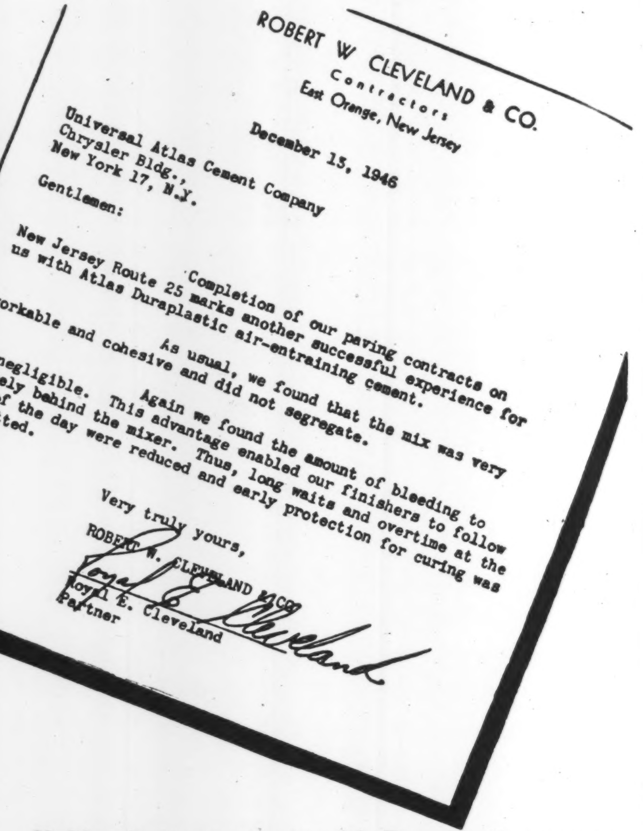
Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
Mar., 1947	391.93	188.40	298.82	161.53	...	...
Feb., 1947	390.76	187.84	297.38	160.75	197	86
Jan., 1947	381.68	183.47	288.78	156.11	195	86
Dec., 1946	368.10	176.95	278.49	150.54	207	91
Nov., 1946	362.47	174.24	273.71	147.96	164	72
Oct., 1946	360.94	173.50	272.74	147.43	233	102
Sept., 1946	360.19	173.14	272.04	147.06	233	98
Aug., 1946	361.37	173.71	271.98	147.02	258	113
July, 1946	353.89	170.11	266.13	143.86	327	144
June, 1946	347.91	167.24	264.16	142.80	344	151
May, 1946	339.69	163.29	257.25	139.06	284	125
April, 1946	334.59	160.83	254.37	137.50	340	149
Mar., 1946	323.83	155.66	245.41	132.66	256	112
Feb., 1946	319.52	153.59	243.94	131.86	167	73
Jan., 1946	316.32	152.05	242.23	130.94	189	83
1946 (Av.)	345.74	166.19	261.87	141.55	250	110
1945 (Av.)	307.74	147.93	239.14	129.27	123	54
1944 (Av.)	298.63	143.39	234.73	126.89	95	42
1943 (Av.)	289.95	139.38	228.75	123.66	176	77


MATERIAL COST PRICES


CONSTRUCTION WAGES

"another successful experience ...with Atlas Duraplastic"





ROBERT W CLEVELAND & CO.
Contractors
East Orange, New Jersey

December 15, 1946

Universal Atlas Cement Company
Chrysler Bldg.,
New York 17, N.Y.

Gentlemen:

Completion of our paving contracts on New Jersey Route 25 marks another successful experience for us with Atlas Duraplastic air-entraining cement.

As usual, we found that the mix was very workable and cohesive and did not segregate.

Again we found the amount of bleeding to be negligible. This advantage enabled our finishers to follow closely behind the mixer. Thus, long waits and overtime at the end of the day were reduced and early protection for curing was permitted.

Very truly yours,

ROBERT W. CLEVELAND & CO.
Royal E. Cleveland
Royal E. Cleveland
Partner

REC:L

Making better concrete with Duraplastic cement is simple . . . no added materials . . . no unusual changes in procedure. The mix is more cohesive and more plastic. It flattens out without segregation . . . bleeding is minimized.

At no extra cost, Duraplastic provides the proper amount of entrained air by intergrinding with the cement the precise amount of air-entraining material needed for satisfactory field performance.

Send for further information. Write to Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, N. Y.

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ENR-D-49

AIR BUBBLES IN CONCRETE . . . MAKE IT MORE DURABLE . . . AND MORE PLASTIC

ATLAS DURAPLASTIC

TRADE MARK REG.
U. A. C. CO.

A UNIVERSAL ATLAS PRODUCT

AIR-ENTRAINING PORTLAND CEMENT

MAKES BETTER CONCRETE AT NO EXTRA COST

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel—Sunday Evenings—ABC Network*

News of the Week

ENGINEERING NEWS-RECORD • MARCH 6, 1947 • VOLUME 138 • NUMBER 10

Limited-access roads needed highway engineers are told

Highway officials of the North Atlantic states believe that the public must be educated to the need for greater capacity and safety regardless of cost

The public should hear about higher traffic capacity of the roads now being planned rather than about the greater per mile cost of those roads as compared to road costs in the thirties, according to speakers at last week's meeting of the Association of Highway Officials of the North Atlantic States held in Atlantic City. The current highway accident toll permits no compromise in designing safety into new highways, other speakers said, and there was general agreement that limited access is a necessity for heavily-travelled through highways.

New officers elected at its first general meeting in seven years are: Walter B. McKendrick, Jr., assistant chief engineer of the Delaware Highway Department, president and W. T. Ballard, chief engineer of the Maryland State Roads Commission, vice-president. A. Lee Grover of the New Jersey highway department continues as secretary and treasurer.

H. C. Whitehurst, director of highways of the District of Columbia and retiring president of the organization, predicted more stable conditions of materials, labor and prices soon. But, he warned, a large volume of awards will skyrocket prices and continue the chaotic conditions in the industry. To speed traffic in cities, he advocated coordination of highway design with permissible vehicle and pedestrian movement. Elimination of left hand turns, limiting of access and simple channelization can greatly increase traffic flow, Mr. Whitehurst said.

Non-stop roads

Non-stop roads into the heart of cities, not a new surface for "Main Street," is the essential demand of urban traffic, according to Wm. J. Cox, Connecticut highway commissioner. Mr. Cox said that "courage of convictions must go with the design to get what we know will be needed in the future," despite the added cost of building in some things that will be necessary to make it practicable to develop roads further in the future. He pointed out that some roads of four 9-ft. lanes, now are relegated to secondary use because of lack of a median strip or shoulders for parking. Mr. Cox suggested further that the federal government should relinquish the gas-tax collection to the individual states or return the full amount collected to the states from which it is taken.

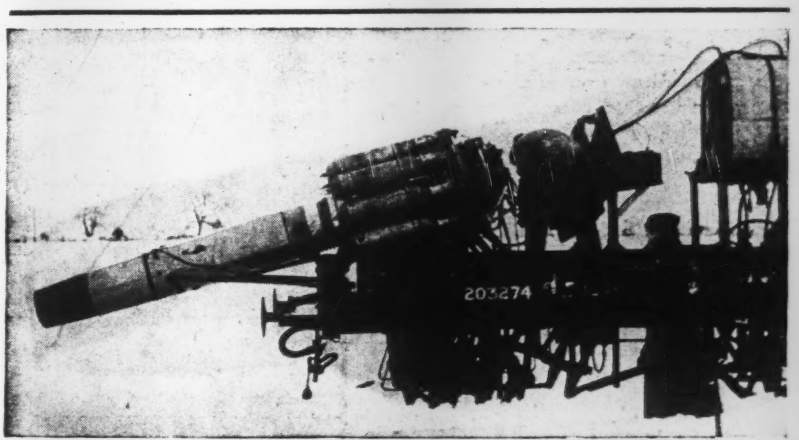
Thomas H. MacDonald, commissioner of the U. S. Public Roads Administration, emphasized that the nation must make a clean break with the past and go all-out for controlled-access design of major arteries of traffic. This would feed vehicles into main streams of traffic only directionally over acceleration lanes and take them out in the same manner, and would eliminate all crossings at grades.

Roads away from urban areas can be designed for 1,000 vehicles per hour per lane, Mr. MacDonald said, though 800 is a better figure where there is a large volume of commercial traffic. A number of tests have given a figure of 688 vehicles per 10-ft. lane passing a given point per "hour of green light", while only 300 to 400 cars per lane per hour of green light passed where parking is permitted.

J. T. Callaway of the Goodyear Tire and Rubber Co., newly-elected president of the American Road Builders Association, told the meeting members could expect the manufacture of 40,000 units of crawler equipment in 1947, the same as the peak year of the war, and other machines in similar numbers. Equipment generally is expected to be reasonably available by the fall of this year.

Engineers and contractors working together to keep highway costs as low as possible and an information program to justify such necessary cost to the public, were recommended by Dwight W. Winkelman, New York Highway contractor and vice-president of the Associated General Contractors of America. Of utmost importance, said

(Continued on following page)



Press Assoc. photo

Jet-Propelled Snow Removal—*A jet turbine engine, built originally for use in aircraft, was converted to a modern-day snowplow by British railroads recently. Mounted on a flatcar, the jet exhaust is directed ahead of the train, melting the snow in its path and blowing away drifts not melted by the heat. Drifts from four feet to 18-ft. in depth have been successfully removed with the apparatus.*

Stress need for limited-access roads

(Continued from page 53)

Mr. Winkelman, is continuity of work so that a contractor can build up a crew *proud* of being a part of a successful construction organization.

Bituminous highways

In a session devoted to bituminous mixes, four speakers gave technical details on developments in connection with highway construction and maintenance.

J. E. Lawrence, maintenance engineer of the Massachusetts Department of Public Works, told the meeting that a number of "anti-stripping" compounds have been developed and give benefits more than offsetting their added costs. These compounds, when mixed with asphalt, permit the asphalt to adhere to wet stone, making it possible to do paving and repair on wet days or with damp aggregates. Massachusetts is using the anti-stripping compounds mixed cold with gravel with either RC-2 or MC-3. Such an additive appears to have no detrimental effect on the bituminous materials with which they are used.

Concerning tar concrete pavements, P. A. Phelan, presenting a paper prepared by A. R. Taylor of the Koppers Company, pointed out that improved equipment has made use of tar concrete for roads economical. Plant mixes for haul to the point of use have made it practical to employ some heating so that most "cold" mixes now are laid at least warm. Tar concrete placed with aggregate at 150-225 deg. F. now is used largely for surfacing and resurfacing and does not require a seal for highway use. Cold mixes for shipment by rail or for long haul by truck are used with a seal course.

Bernard E. Gray, general manager of the Asphalt Institute, advocated placing asphalt both under and over old pavements as the proper method of reconstructing rigid highway surface. Use of an under-seal of high-melting-point asphalt intruded through drilled holes at a rate up to 25,000 gal. of material per mile cost less than 25 cents per sq.yd. This is less than the cost of one inch of resurfacing material, which, in Mr. Gray's opinion, would be replaced by this process, as the new surface can then be made correspondingly less thick without danger of cracks or the risk of having the old pavement break through the new surface.

Commenting on new pavements, Mr. Gray said that 4 in. of asphalt is sufficient if over an adequate base. He cited breakdown tests at Stockton, Calif., Army Air field where wheel-loads up to 150,000 lb. have been satisfactorily carried by all of the test sections which ranged from 4 to 15 in. thick. Wheel-loads of 200,000 lb. caused some breakdown.

C. L. McKesson, consultant to the American Bitmuls Co. outlined the advantages of the cold-mixed, cold-laid asphaltic concrete as follows: (1) expensive paving plants are not required; (2) Elimination of heating avoids damage to the asphalt, saves plant and fuel cost and speeds output; (3) Only simple spreading and rolling equipment is required; (4) Thickness may be varied as desired from a feather edge to several inches.

Other papers

Other technical papers of particular interest included one on secondary roads by Warren K. Myers, maintenance engineer of the Pennsylvania Department of Highways. Such roads, Mr. Myers said, can be built by state maintenance forces, thus providing organized forces which can be used for snow handling and other emergencies.

Cost for a flexible type pavement in Pennsylvania in 1931-34 was $6,500 per mile, of which $2,000 to $2,599 was for grading and drainage, while the rest was for base and surface. Costs in 1946 on work done by state forces (generally under more difficult conditions and with shipped-in materials) are $6,000 to $12,000 for grading and drainage, $10,000 to $15,000 for the base, with an additional $2,500 to $7,000 for surface to give a total of $20,000 to $35,000 per mile. Greatly increased labor and equipment costs are largely responsible for the current high figures. Average maintenance cost from 1931 to 1946 has been $458 per mile per year.

Developments in concrete

Advantages of the rolling method of determining percentage of air entrainment of concrete were discussed by L. E. Andrews, eastern regional highway engineer of the Portland Cement Association. Air in a closed vessel containing concrete is replaced by liquid as the vessel is rolled to "tumble" the concrete giving a more rapid and accurate determination of air held. Mr. Andrews advocated its use as preferable to the pressure method.

Experiments with 3 to 6 percent of air entrainment in concrete have given uniformly good results in the North Atlantic States, Mr. Andrews said. Strength in flexure is reduced 2 percent for each 1 percent of air held, but bleeding and segregation are reduced and subsequent scaling of the pavement surface appears to be prevented.

Calcium chloride in the mix or on top of the concrete has proved beneficial to the concrete by acting as a curing agent and increasing the resistance to wear, according to a paper presented by H. C. Vollmer, research engineer of the U. S. Bureau of Standards. Mr. Vollmer stated that the early curing of concrete after laying is important, and that three days curing with damp burlap is adequate. Humidity in some areas is sufficient for moisture without wetting down, but changing conditions make no water application a questionable procedure.

Soils should be analyzed and stresses computed the same as for any other structural material by an experienced, competent engineer not a laboratory mechanic, said Earl F. Bennett, principal soils engineer of the New York State Department of Public Works. New York State has reduced 75 "agricultural" types of soil into eleven engineering types and supplies road designers with a map showing the soils and possible road materials along proposed routes. Mr. Bennett suggests more tolerance on depth of layer of fill, on amount of moisture, and on the mechanics of rolling as aids to securing lower costs on construction.

Discusses mapping

Advances in photogrammetric mapping and processes available for current use were outlined by W. H. Meyer, Jr., of Lockwood, Kessler and Bartlett, Inc. This firm is adding its own aerial surveying department for map making. Map pictures suitable for preliminary location, made at a scale of 200 ft. to the inch with 5 ft. contours, and for a mile of width, can be made at a cost of $1,000 per mile if as much as 10 miles is involved in a single project. Much more accurate maps are available, however, taken with long focal length cameras from 4,800 ft. elevation, using a negative 9x18 in. in size.

TRAFFIC TIMING

Average clearance between vehicles moving on the highway is one second. A car requires a 61 second "hole" in passing traffic to cross a road. A string of cars entering at an intersection requires 3.8 sec. for the first car to enter the stream of traffic an additional 3.1 sec. for second, down to 2.1 sec. after the fifth. Trucks require 1½ times the intervals given for passenger cars.

The above is from studies made by the Bureau of Highway Traffic of Yale University and is condensed from a paper presented by Donald Schapiro.

Oppose federal agency interference in stream pollution control activities

National Council for Stream Pollution Improvement hears state action urged—New Jersey, North Carolina report progress

Federal government control of pollution abatement in the nation's streams, as proposed by a bill introduced in Congress last year (*ENR* June 13, 1946, vol. p. 932), would be undesirable and ineffective in meeting local problems, members of the National Council for Stream Improvement said last week.

Meeting in annual convention at New York City, the group heard speakers strongly advocate control of pollution through action by states, municipalities and industries concerned.

In sharply parallel actions, sanitation organizations in New Jersey and North Carolina at the same time submitted to state governments comprehensive pollution-control programs, calling for expenditures of huge sums of money.

Opposition to the current move toward national supervision of anti-pollution work was the unanimous theme of talks by Morris Cohn, consultant to the Committee on Stream Pollution of the New York State legislature; William S. Wise, chief engineer for the Connecticut State Water Commission and Dr. Willem Rudolfs, director of the department of sanitation at Rutgers university.

The three men pointed out the vast size of the pollution abatement task—a $2,000,000,000 program calling for construction of some 10,000 new treatment works—but declared that the problems are so complex, and demand so much in the way of appreciation of local needs that federal control would be impractical.

State control first

On the other hand, they said, states can undertake abatement programs as a supplement to the common law, and can work more closely and more sympathetically with the local industries and municipalities.

Commenting on general control activities, Mr. Wise warned his listeners that programs should not attempt to attain the impossible in stream purity. "A state program must be based on an honest appraisal of the many elements and factors contributing to the general welfare. A happy medium must be worked out between the unattainable extreme of pristine purity and the unforgivable extreme of gross pollution."

Following the lead of the many states already prosecuting control programs a survey in New Jersey has indicated that that state and its components must spend about $80,000,000 to correct existing stream pollution problems, according to State Health Director Mahaffey. He added that the estimate is a minimum figure.

The program, Mr. Mahaffey said, is needed now more than ever because of the piling up of war-deferred projects. The figure for new plants and other work does not include the municipalities, not now sewered, which are preparing or have had prepared plans for comprehensive systems and treatment works.

In North Carolina, the State Stream Sanitation and Conservation Committee last week submitted to the legislature a report on recent detailed surveys of the state's problems, urging "large amounts" of engineering planning, and construction work to clear the state's streams.

"Most of the cities and towns are not completely sewered," the report said, "and their boundaries have enlarged and their populations increased so that many residents must resort to outside septic tanks."

Headed by J. M. Jarrett of Raleigh, a sanitary engineer, the committee urged enactment of anti-pollution legislation that would, among other things, provide protection for manufacturers who establish proper treatment plants.

Ozonation unsuccessful at Kelso, Wash., plant

A sewage plant at Kelso, Wash., which proposed to use ozonation as the principal means of treatment, has been operated not more than two weeks since its completion last fall by the Amozone Co. of Oregon, according to Robert Leaver, district engineer for the Washington State Department of Health. The plant has been partially dismantled and completely shut down and locked up, while the city awaits action by the company.

During operation, the effluent "looked very good," Leaver said, but nothing was done with respect to the final disposal of accumulated sludge. The ozone generator failed to function satisfactorily, apparently because air could not be sufficiently dried out before passing through the machine. No way was found to keep plates from burning out during operation, Mr. Leaver said in a report on the operation.

Pay only if successful

The Amozone Co., headed by Edward S. Marnon, built the Kelso plant at a reported cost of $30,000 on the understanding it would receive payment only if the plant proved successful.

The plant was intended to serve only West Kelso, the city proper being part of a county sewer district, and served by its facilities.

The Northwest Sewage Works Association, at its convention last summer, warned communities "from entering into proposals which claim ozonation as the principal means of sewage treatment," (*ENR* June 20, '46, vol. p. 948).

Wide World photo

***Snow Removal Made Easy**—Recent heavy snowfalls in New York City held no terror for maintenance employees of Best and Co., at 50th St. and Fifth Ave. Radiant heating pipes installed under the sidewalk, connected to the store's heating system, created an oasis in the foot-deep snowdrifts.*

Home builders ask control removal

Removal of all federal controls on construction—including the limitation on non-residential building—was recommended in a policy statement by the board of directors of the National Association of Home Builders after the organization's five-day convention in Chicago last week.

The declaration came after conflicting opinions had been expressed at convention sessions by home builders and representatives of government, industry and veterans' organization regarding the advisability of temporarily retaining present controls.

Attendance at the convention (more than 5,500 registered), was broadly representative of the home building industry throughout the United States.

Increased rentals announced

As a stimulant to building of apartments. increases in rentals to $30 and $32 per room per month, including service charges. for "hardship" cases of new rental housing construction in large metropolitan areas (restricted at present to New York and Chicago) were disclosed by Frank R. Creedon, national housing expeditor. and Raymond M. Foley. national housing administrator. Each application for higher rent than the $80 monthly average now permitted nationally will be judged on its merits. they stated.

Mr. Creedon declared that the $50,000.000 weekly limitation on non-residential building must be retained for a time to prevent excessive diversion of building supplies and labor to commercial and industrial construction.

Present flow of applications for rental housing is encouraging. the two men said. but Mr. Foley admitted in an "offhand estimate without benefit of figures for reference" that rental applications now represent only about 20 percent of current volume. A large portion of the apartment house applications are for smaller buildings containing 24 to 30 living units, regarded as a favorable omen for quick action and early completion.

Labor shortage in prospect

Appraising the labor outlook for a $15.5 billion volume of new construction in 1947. E. R. Lerner. director. Labor Branch. Office of the Housing Expediter. quoted estimates of the Bureau of Labor Statistics in making a statement that "at the peak of the building season. 925.000 workers will be needed on residential building, 780,000 on non-residential building, and 835,000 on other types of construction, such as highways and dams. Compared with 1946, this means an increase of 300,000 workers for home building. 175.000 for non-residential building, and 295.000 for other construction."

To increase the number of building trades apprentices, contractors and labor organizations in more cities and communities must take part in the apprenticeship training movement by establishing programs, declared William F. Patterson, director, Apprentice-Training Service, U. S. Department of Labor. On Feb. 1, there were about 90,000 apprentices in training, he said, and more than 2,200 trade-wide apprenticeship programs had been set up in cities of the United States—twice as many as a year ago, but more are needed.

Edward R. Carr. Washington, D. C., was elected president of the association for 1947.

Charge Sewer Pipe Assn. with price-fixing

Charging unlawful combination to fix prices and suppress competition. and illegal price discrimination, the Federal Trade Commission has issued a complaint against the Clay Sewer Association, Inc., of Columbus, Ohio, and 20 manufacturers of vitrified sewer pipe, who are among the membership.

The complaint charges that for more than five years these concerns have adopted and continued a common course of action resulting in the prevention of competition in the sale of their products. The 25 plants of the respondents constitute one-third of the total number in the United States engaged in the manufacture of vitrified sewer pipe. FTC said. A number of alleged overt acts and practices listed have made the agreement among the respondents effective, the complaint charged.

Utility asks new hearing on Clark Hill

The Savannah River Electric Co. has petitioned the Federal Power Commission for a rehearing on its application to construct the Clark Hill flood control and power project on the Savannah River

Shortly after the utility's petition was filed the Army authorized its District Engineer's office at Savannah, Ga., to proceed with construction of the project by breaking it up into a number of small contracts (*ENR* Feb. 20 vol. p. 255). The Corps of Engineers previously had twice rejected bids for construction of the dam.

In a much-discussed opinion handed down recently (*ENR* Jan. 30, vol. p. 170) FPC dismissed the company's application on the general grounds that the Clark Hill project was being built by the Engineers in accordance with previous recommendations by the commission for federal development of the river.

Savannah River Electric, a subsidiary company of the Georgia Power Co., contends in its petition for rehearing that all of the findings in FPC's dismissal order were "contrary to law and contrary to the evidence presented" in the proceeding.

The commission's finding that more than $2,000,000 had been obligated on construction by the Engineers, the company held, was "innaccurate and misleading".

The company also objected to FPC's statement that the Engineers were proceeding with the project "as authorized for construction by the United States in the Flood Control Act of 1944. The 1944 act authorized a project which would cost $35,300,000, but "the uncontradicted evidence is that a project such as that proposed by the applicant and as presently contemplated by the Army Engineers will cost $45.000.000."

Large extensions planned by Ohio public utilities

The Cleveland-Electric Illuminating Co. is planning a $57,000,000 program of extensions and improvements, for 1947. The company plans to spend $41,000,000 on new projects, while $16,000,000 will be required to complete those already started. The major items include:

Installation of two 90,000-kw. turbogenerators with boilers and accessories: completion of four substations. building of which was started in 1946; construction of five more substations and addition to another substation; completion of reconstruction of Canal Road steam heating plant to increase its efficiency and capacity.

Plans for construction of a 190.000-hp. steam electric power plant on the Ohio River near Pomeroy, Ohio. at an estimated cost of $20 million has been announced by Ohio Power Co., Canton. The company expects to have under construction another generating unit of the same capacity by that time. The plant will be located near a large coal field ample to supply it for 30 years. It will give Ohio Power four generating plants. and boost capacity to nearly 1.200.000 hp. The company serves consumers in 55 Ohio counties.

ACI sees greater prospect for precast concrete and air-entraining cement

American Concrete Institute meeting at Cincinnati covers a wide range of technical reports—Stanton Walker elected president

Following its customary practice of concentrating a great deal of technical discussion in a 3-day meeting, the American Concrete Institute at its 43rd annual meeting last week in Cincinnati, Ohio, heard discussions on problems of vital importance in the fields of concrete design, construction and maintenance.

Significant of the widespread use of air-entrained concrete was the fact that no arguments were advanced as to its relative merits, as was the case at last year's meeting in Buffalo, N. Y. (*ENR* Mar. 21, 1946, vol. p. 427). Instead, considerable discussion was centered on the simplification of field methods of measuring the amounts of air entrained in concrete.

Apparatus developed and methods perfected, during the last year for conducting these field tests were discussed in detail by Carl A. Menzel, senior research engineer, Portland Cement Association Research Laboratory, Chicago, Ill. Abstracts of his as well as other technical papers presented at the convention will be published in a subsequent issue of *ENR*.

Precast reinforced concrete

One entire session was devoted to the application and extended use of precast reinforced concrete to both housing and industrial building construction. Other topics of timely interest commanding the attention of the 296 engineers, research men, contractors and others of the industry in attendance at the meeting included the construction and maintenance of concrete structures, design of reinforced concrete and tests on reinforcing bars, concrete cracking and proposed revision of the institute's building regulations for reinforced concrete. Favorable action was taken at the convention paving the way for final adoption of these revised building regulations by means of a letter ballot of the entire membership.

Officers and awards

Stanton Walker, director of engineering of the National Sand and Gravel Association and of the National Ready Mixed Concrete Association, Washington, D. C., was elected president of the ACI for 1947. He succeeds H. F. Gonnerman, director of research, Portland Cement Association, Chicago.

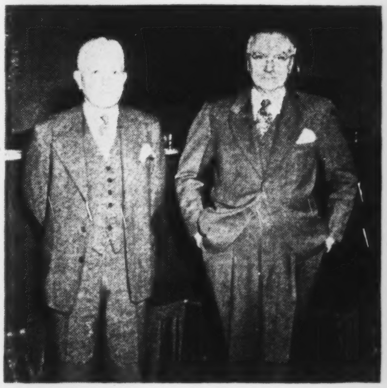
Other new officers of the institute include: Herbert J. Gilkey, Iowa State College, Ames, Iowa, vice-president; and regional directors W. H. Klein, Pennsylvania-Dixie Cement Co., Easton, Pa., Charles H. Scholer, Kansas State Agricultural College, Manhattan, Kan., and Arthur J. Boase, Portland Cement Association, Chicago.

Reelected officers are: Robert F. Blanks, Denver, Colo., vice-president; Harry F. Thomson, St. Louis, Mo., director-at-large; and regional directors Paul W. Norton, Boston, Mass., R. R. Zipprodt, New York City, and H. P. Bigler, Birmingham, Ala.

In recognition of forty years of outstanding contributions to the industry's knowledge and understanding of concrete and reinforced concrete, Morton O. Withey, dean, College of Engineering, University of Wisconsin, Madison, Wis., was awarded the Henry C. Turner Medal.

The Leonard C. Wason Medal for the most meritorious paper published in ACI *Preceedings* last year went to Professor Gerald Pickett, Department of Applied Mechanics, Kansas State Agricultural College, author of "Shrinkage Stresses in Concrete" (ACI *Journal*, Jan. and Feb. 1946).

The Leonard C. Wason Medal for noteworthy research went to Charles E. Wuerpel, chief of the Concrete Research Division, U. S. Waterways Experiment Station, Clinton, Miss., for the work reported in his paper, "Laboratory Studies of Concrete Containing Air-Entraining Admixtures."



Concrete Institute Heads—*H. F. Gonnerman (left), of Chicago, Director of Research for the Portland Cement Association, has just relinquished his post as president of the American Concrete Institute to Stanton Walker (right) of Washington, D.C., who is in addition Director of Engineering for both the National Sand and Gravel Association, and the National Ready Mixed Concrete Association.*

Propose increased dues

A recommendation by the board of directors for a revision of the by-laws providing for increases in membership dues effective July 1, 1947, was approved by the convention and will be submitted to the membership for final vote by mail ballot. If approved it will increase yearly dues in the following amounts: corporation membership increased by $5; individual membership by $2.50; juniors by $1.50 and student membership by $2.

Harvey Whipple, secretary-treasurer, announced that next year's meeting will be held in Denver, Colo., during February.

◆

Committee to report on Purdue bleachers failure

An investigating committee representing Purdue University and the Indiana state government is expected to render an opinion shortly on the cause of the bleachers failure in the Purdue fieldhouse between halves of a basketball game Monday evening, Feb. 24.

Collapse of the bleachers—supporting about 3,500 spectators at the time—has resulted in three deaths, critical injuries to eleven, and less serious injuries to more than 1,000.

Pending the committee's report, no official opinion on the cause of the disaster is available. The committee held its first full meeting at the University March 1, under the chairmanship of Prof. J. L. Bray, head of the chemical and metallurgical engineering school. Allis E. Stuart, president of the Purdue Board of Trustees, appointed ten members of the committee, including R. E. Mills and P. E. Soneson, professors in the civil engineering schools.

The bleachers which failed were of the common, portable, wood-frame type with steel fastenings, first erected last fall for a football game and later moved to the fieldhouse for the basketball season. Wooden A-frames supported the sloping stringers, which were attached at the bottom to horizontal base members in the same plane by a hook-shaped steel connection which could readily be dismounted.

The assembled unit, about 30 ft. high and 100 ft. long, comprised 44 tiers of seats. Collapse apparently started in the lower center of the stand and progressed to the top and toward the ends in what is described as a sort of subsiding wave.

HIGHLIGHTS OF MUNICIPAL DEVELOPMENTS

Plan $8 million ship terminal for Charleston, S. C.—Indianapolis considers $10 million expenditure on airport—Buffalo, N. Y., discusses $5 million improvement program—Other news

The South Carolina State Ports Authority last week revealed plans for an $8,000,000 project to raze existing dock facilities along the Cooper River at Charleston, S. C., and construct a new terminal.

C. P. Means, authority vice-chairman, said the new terminal will parallel the river channel for 3,000 ft. south of the Grace Memorial Bridge, and added that work will start this year and that the project will be completed in 18 months.

Existing facilities at the city's Columbus Street wharf can accommodate only ships with an overall length of 2,500 ft. When new work is completed, six vessels will be handled simultaneously.

Mr. Means said that long-range plans for development of Charleston harbor call for construction of all docks and wharves parallel to the channel, to eliminate the problem of dredging and offer quicker and cheaper berthing.

Buffalo plans improvements

The Temporary Capital Expenditures Committee of Buffalo, N. Y., recently recommended a bond-financed program of 25 municipal projects for 1947, at an estimated total cost of $5,780,000.

The largest single project is a new incinerator plant on Squaw Island, to cost $1,000,000; and the next largest is a $750,000 garage for the streets division. Other projects recommended include: $725,000 for installation of a new water line to the Grover Cleveland water tower and new pumping equipment; $450,000 for a warehouse and garage for the School Department, and $500,000 for rehabilitation and improvement of city buildings.

New water source

Chester, Pa., is seeking authority from the Pennsylvania Public Utility Commission to change its water supply from the Delaware River to Octraro Creek, Chester County, with the cost of the changeover estimated at $9,000,000.

Frank I. Dodd, manager of the Chester authority that operates the city's water system told the commission that the high salt content of the Delaware River causes a heavy loss to industry and that many of the plants obtain water from other cities.

Francis J. Friel, Chester's consultant engineer, described the Delaware River as "a grossly-polluted stream which falls short of U. S. public health requirements. Philadelphia alone dumps 330 mgd. of sewage into the river. Even with the erection of modern treatment plants by Philadelphia, 30 percent of the sewage would still remain untreated."

The authority is seeking commission approval of its plan to purchase all the Octraro Water Co.'s facilities south of McCray, Chester County, for $235,000 and then make the changeover from river to creek water at a total cost of $9,000,000. The Federal Works Agency has advanced $179,500 to the city of Chester to finance the preparation of drawings and specifications.

Seattle looks ahead

If Seattle, Wash., continues to grow during the next 18 years at the same rate at which it grew from 1922 to 1946, the municipal water department should be prepared to spend about $28,490,000 for improvements and expansion, Superintendent W. C. Morse declared last week in a forecast of departmental needs.

In the next three years, Mr. Morse said, more than $7,000,000 should be spent, including $2,240,000 for expansion of reservoir capacity, if the department is to maintain its present level of storing about 1,000,000 gallons of water per 1,000 population. One major need foreseen in the report is construction of a 72-in. main on the east side of Lake Washington, to carry water from the Cedar River area to a proposed new reservoir that would be built north of the city.

Indianapolis airport built

Indianapolis, Ind., city officials are considering the expenditure of $10,000,000 for improvements at the city's Weir Cook Airport, over a 10-year period. Of this sum, $3,000,000 would be provided by the city, and the balance would come from federal grants, airlines, and commercial sources.

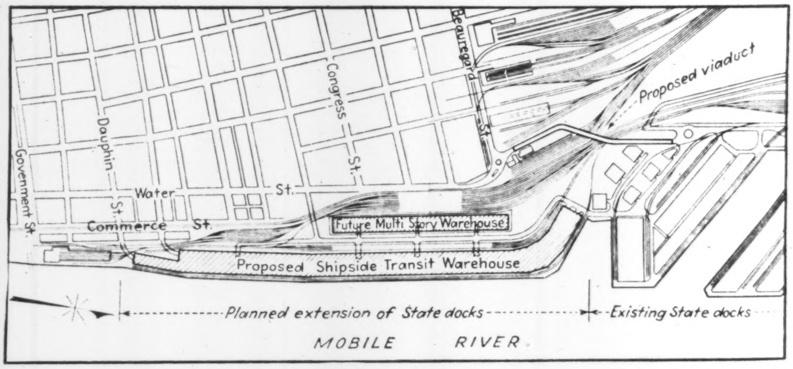
Tentative plans call for consolidation of ticket-selling, repair, passenger accommodations and radio and teletype services in an administration building and in other structures.

Water for Hialeah

Anticipating that the city's population (now about 7,000) will more than double in the next 10 years, officials of Hialeah, Fla.—a suburb of Miami—last week considered expenditure of $700,000 to increase the city's water supply capacity. The municipality now obtains its supply from Miami.

Seek paving material

Officials of Toledo, Ohio, are searching for low-cost paving materials to surface the city's last 100 miles of unpaved streets. City engineers have decided to conduct a series of surveys and soil tests to determine the most economical type of surfacing materials for use in residential areas.



Docks Expansion for Mobile—*The Alabama Department of State Docks recently announced plans for expansion of marine terminal facilities at Mobile, at a cost of more than $4,000,000. The state has acquired the entire waterfront south to Dauphin Street through condemnation of existing railroad docks and municipal wharves, and the city government is taking steps to vacate the waterfront north of Congress Street. Additionally, the city has voted a fund of $220,000 toward the development.*

Army calls rivers work "sufficient" for present

The War Department Corps of Engineers has informed Congress that it is satisfied with the present backlog of rivers and harbors authorizations. Lt. Gen. R. A. Wheeler, corps chief, is not asking for any more authorizations from the present session of Congress.

General Wheeler outlined his plans Feb. 28 at a get-acquainted session with members of the House Public Works Subcommittee on Rivers and Harbors. Col. P. A. Feringa, director of the corps' civil works, and Col. Wayne S. Moore, resident member of the board for rivers and harbors, also testified briefly.

Committee Chairman George A. Dondero, R., Mich., simultaneously announced that the full committee will meet soon to consider the fact that the Engineer Corps, under past congressional authorizations, has preliminary surveys under way on 1,164 flood control and navigation projects at a cost of $4,000,000 annually.

General Wheeler assured the subcommittee that the corps makes periodic reviews of authorized projects to determine whether changes in the economic ratio of costs versus benefits indicate that they should be shelved. He advocated that before any authorizations are withdrawn, however, local interests should be given a chance to be heard.

"We have such a large backlog of authorizations for which there are no appropriations that we are not proposing any new authorizations at this time," General Wheeler told the subcommittee.

The Chief of Engineers said that work is under way on about $3,500,000,000 worth of flood control and rivers and harbors improvement. The remainder of the authorizations, he urged, should remain on the books to take their turn as appropriations are forthcoming.

Colonel Moore said his department has about 710 authorizations for preliminary examinations. He anticipated that about one-half of them will result in adverse reports and that perhaps 300 will be recommended for surveys.

Colonel Feringa reported briefly on 19 bills pending in the House committee. He said formal reports soon will be forthcoming on ten of them. The list includes the St. Lawrence Seaway proposal, three bills on stream pollution control, a bill for flood control works on the Arkansas and White rivers, and provision for toll-free bridges at Cascade Locks and Hood River, Oregon.

New restrictions placed on importing of surplus equipment from abroad

Regulations governing the importation of surplus property from foreign areas revived by the Office of Temporary Controls to eliminate construction equipment not in short supply

Most of the items of construction equipment on the list of former government owned surplus equipment that could be imported to this country that was issued by the State Department on Jan. 18, 1947, were removed from that list by an order issued on Feb. 20 by the Office of Temporary Control of the Office of War Mobilization and Reconversion.

The Department of State's order of Jan. 18 was issued in response to requests to the department that permission be granted for the return to this country of surplus materials and equipment that were in critically short supply. Some of this equipment already had been sold at considerably less than cost to the government. As a result, it was possible for foreign purchasers to bring some of this equipment back to this country and undersell distributors in this country.

This situation was the subject of a strong protest at the meeting of the Associated Equipment Distributors held in Chicago in February (*ENR*, Feb. 20, vol. p. 257). The new order issued Feb. 20, effective Feb. 25, apparently was a result of that protest and of similar protests from other organizations. It removes from the list of equipment that can be imported to this country the following items of construction equipment. All sizes of trucks, both new and used, including jeeps; tractor-mounted, wheel-mounted and truck-mounted cranes; crane attachments for earth moving, shovel fronts, draglines and clamshell buckets; ditchers and trenchers; drawn road graders; motorized and drawn scrapers, carrying type, 6 cu.yd. and larger; tractor attachments in excess of one per tractor; and wheel-type tractors, 10-35 hp.

As a result of this order, few items of construction equipment are now left on the exempt list.

Santee-Cooper suit seeks to recover $191,140

The amount that the South Carolina Public Service Authority will undertake to collect from the New York Casualty Company as a result of the failure of the Wright Contracting Co. to carry out its contract for riprap work in connection with the Santee-Cooper project is $191.140, not $390,000 as stated in *ENR* Feb. 13. vol. p. 244. The bid bond was 5 percent of the contract price of $3.822,800.

The Feb. 13 statement with respect to the relation of the Wright company bid to the bid of the firm now carrying out the work also was in error. The low bid submitted by the company was on Schedule 4, which was for placement of dumped riprap in both upper and lower zones on Santee Dam. The next low bid was that of Grannis, Thompson and Street Co. of Charlotte, N. C., on Schedule 3 in the amount of $4,243,159, on which a contract now has been executed. It was for a combination of reinforced-concrete slab in the upper zone and dumped riprap in the lower zone. Negotiations have been completed whereby the contractor is to place dumped riprap in both zones in accordance with the specifications of Schedule 4 for the same amount as his bid on Schedule 3.

Report high profits on Ohio toll bridges

A report of the Ohio State Bridge Commission for 1946 recently revealed that profits reached a new high for the operation of four toll bridges, despite the fact that two of them—the Sandusky Bay bridge and the Pomeroy-Mason bridge—were made toll free during the year. The commission recorded net profits of $671,515. Other records also were established by the commission's operations, including the payment of $700,000 in bridge revenue bonds, and the fact that more than five million vehicles used the four spans.

The total gross income of $874,742 would have been a record, if three bridges had not been repainted and two others put in "first class" condition before they were turned over to the state highway department, the report said.

The Sandusky Bay bridge, which became toll-free Aug. 30, 1946, showed net profit of $190,954 for the period; the Pomeroy-Mason bridge, made toll free Oct. 31, 1946, showed a profit of $45,311; the net profit from the Steubenville-Weirton bridge was $198,179 for 1946, and commission expects this bridge to become toll free either this summer or fall; and net income from the East Liverpool-Chester, W. Va., bridge last year was $237,078.

Start Delaware River tunnel study

A new survey of traffic and probable revenues to be derived from a vehicle tunnel under the Delaware River about 10 miles below the Philadelphia-Camden Bridge is being made by Day & Zimmerman. Philadelphia consulting engineers, for the First Boston Corporation, which heads a syndicate of bankers interested in financing the project.

Construction of a tunnel from the southern part of Philadelphia to New Jersey south of Camden was proposed in 1934 by private interests, but when the RFC was approached for a loan, it recommended that the tunnel be built by public bodies. As a result, the Delaware County Pennsylvania Authority was created in 1936 in Pennsylvania and the Gloucester County Tunnel Commission was set up by New Jersey in 1938. Application for an RFC loan was made in 1939, and in 1941 the RFC stated that it would give favorable consideration to a loan application after the war. At that time, private bankers were prepared to advance $17,700,000 for the work on the basis of traffic studies made by Day & Zimmerman. The cost of the project now is estimated at around $25,000,000.

Plans call for twin tubes 7,000 ft. long, 29 ft. inside diameter of reinforced concrete built in drydock and sunk in a trench dredged across the river. Approach highways on both sides of the river are not included in the cost estimates, it being assumed that they will be built by the state highway departments. No such highways are included in the present plans of the Pennsylvania or New Jersey departments.

Designs for the tunnel were made by Bader, Young & Schultze, architects and engineers, Philadelphia.

Twenty-five miles farther downstream, the Delaware Highway Department is pushing plans for a high-level bridge over the Delaware River near the site of the Pennsville ferry to New Jersey on the North-South route followed by motor traffic attempting to avoid the Philadelphia region. That department has set up a special division headed by Lt. Gen. Eugene Reybold (retired) to expedite construction (*ENR* Oct. 11, 1945, vol. p. 471). The War Department has held hearings on the proposal (*ENR* Nov. 21, 1946, vol. p. 694) and the state has authorized an expenditure of $25,000,000 for the bridge. Designs for it were made by Howard, Needles, Tammen & Bergendoff, New York, and the traffic studies by Coverdale & Colpitts, New York.

Lack of funds halts Anderson Ranch Dam

Lack of funds has brought construction work on the Anderson Ranch Dam near Boise, Idaho, to a halt for the remainder of the fiscal year 1947, R. J. Newell, regional director of the Bureau of Reclamation, announced in the Idaho capital.

Explaining that a "stop-work" order had been given the contracting organization of Morrison-Shea-Twaits-Winston through the reclamation bureau's chief engineer at Denver, Newell said that completion of the project, total cost of which is now estimated at $20,000,000, will be delayed at least until the spring of 1949.

The dam, which was originally placed in construction in August, 1941, was scheduled for completion by the irrigation season of 1946. This summer a net storage of about 130,000 acre-ft. will be provided by the project for irrigation water users, as contrasted with the 500,000 acre-ft. of storage which the dam will provide upon completion.

The present shutdown of construction work is only one of a series of obstacles which has led Newell to term the project "exasperating."

First stoppage in work on the 456-ft. high earthfill dam on the south fork of the Boise River occurred in December, 1942, on order of the War Production Board, and it was almost a year before work was resumed.

Subsequently, materials and labor shortages, and lack of replacement parts and tires for trucks helped slow construction.

Since then, money for the project has been financed on a year-to-year basis, with budget requests of the reclamation bureau frequently reduced. An appropriation of $2,847,000 was asked for fiscal 1947, with the figure ultimately cut to $1,234,475.

The budgeted allowance for 1948 is $4,136,000.

A multiple-purpose project, the Anderson Ranch Dam will provide a supplemental supply of water to about 340,000 acres of highly developed Boise Valley farmland.

Newell said the dam's original cost estimate of $13,100,000 was based on labor and material costs. The dam is being built on a cost-plus basis, he added.

The embankment is virtually complete, but the mammoth 339-ft.-high spillway and the power plant remain to be built.

Invite national agencies to Indiana water parley

Invitations have been sent to water control agencies of 15 states and to engineers of five federal agencies asking their attendance at a general water control conference to be held in Indianapolis, Ind., May 7-8. The meeting will be an attempt to unify and improve flood control and water supply projects in the Ohio and upper Mississippi basins.

David H. Harker, chief engineer of the Indiana Flood Control and Water Resources Department, said that states invited to the May conference include Minnesota, Pennsylvania, Tennessee, West Virginia, Wisconsin, Kentucky, Michigan, Missouri, Kansas, Ohio, Indiana, Illinois, Arkansas and Oklahoma.

◆

Potomac commission adds support to control bill

At its quarterly meeting last week at Frederick, Md., the Interstate Commission on the Potomac River Basin passed a resolution adding the commission's support to the Spence Pollution Control bill (H.R. 315) now before Congress.

This bill, which has also been introduced in identical form in the Senate as S. 418, centers the federal program in the U. S. Public Health Service. It authorizes appropriations up to $100,000,000 annually for loans and grants to local government groups and private industry. The bill also provides $1,500,000 yearly for studies and planning.

The interstate commission announced at the meeting that it will soon publish a waste treatment guide, being prepared by the commission's research committee.

Maryland, West Virginia, and the District of Columbia have approved the water quality criteria and area classification map for the Potomac Basin, the meeting was told. The criteria and the map (*ENR* June 27, 1946, vol. p. 991) are expected to be approved at an early date by Pennsylvania, leaving only Virginia to take action.

MAJOR MEETINGS

Mississippi Valley Conference of State Highway Departments, 38th annual meeting, Edgewater Beach Hotel, Chicago, Ill. Mar. 14-15.

American Railway Engineering Assn., Palmer House, Chicago, Ill., Mar. 18-19.

American Society of Civil Engineers, spring meeting, Westward Ho Hotel, Phoenix, Ariz., April 23-25.

OBITUARY

John R. W. Davis, retired chief engineer of the Great Northern Railway, died Feb. 21 at Seattle, Wash., where he had lived since 1941. He had been associated with the Great Northern since 1903 and had charge of construction of the 8-mile long Cascade tunnel in Washington state. Mr. Davis was a charter member of the American Society of Civil Engineers and of the American Railway Engineering Association. He was a graduate of Lehigh University.

David E. Ball, 49, superintendent of the Yakima reclamation project, died Feb. 22 in Yakima, Wash. Born in Iowa and graduated from Iowa State College, Mr. Ball entered the employ of the Reclamation service on the Yakima project 27 years ago.

Samuel Jefferson Chapleau, 79, well known in Canadian engineering circles, died at Ottawa Feb. 25. He was consulting engineer in the Department of Public Works until retirement eight years ago.

Franz A. Kartak, 59, who was dean of Marquette University college of engineering until his retirement three years ago, died Feb. 18 in Milwaukee, Wis. He was graduated from the college of engineering of the University of Wisconsin in 1909 and served there as research assistant and instructor, until he became director of the Wisconsin state standards laboratory of research and engineering in 1913. In 1921 he joined the Marquette faculty and was appointed dean in 1928.

John Douglas Davis, 61, of Baltimore, Md., died Feb. 17. He joined the Baltimore District, Corps of Engineers, in April, 1935, and was first assigned to field work on the Eastern Shore of Maryland, including the project for deepening the approaches to the Chesapeake and Delaware Canal. For the last several years he was stationed in the district office, where his principal duty had been the preparation of government estimates for construction contracts. Mr. Davis was graduated from Louisiana State University in 1907 with a Bachelor of Science degree in civil engineering.

Edward R. Bates, 61, contractor and builder of Saint John, N. B., died Feb. 18. As a general contractor Mr. Bates had carried on the business founded by his father 52 years ago.

Jules Eugene Rosenheld, 83, a bridge construction engineer in Chicago, Ill., for many years, died Feb. 20. For 25 years he had been manager of the steel department of the Great Lakes Bridge & Dock Co., retiring in 1939. Before that he was an engineer in the Chicago Department of Public Works, and designed and constructed many bridges over the Chicago River and its branches and canals. He was president of Rosenheld and Gallery Construction Co., and served as consultant during the erection of the Golden Gate Bridge.

Joseph G. Bellanca, 76, founder of the Bellanca Construction Co. of Buffalo, N. Y., which he operated for 39 years, died Feb. 17. He remodeled the Erie County Hall and built schools, churches and other public structures.

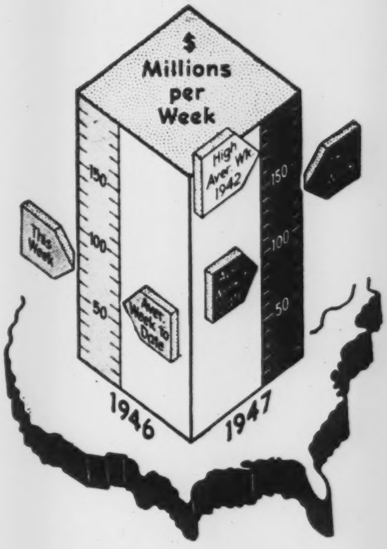
Garabed G. Heghinian, 77, a graduate of Central Turkey college, who in 1900 was the first student of the Massachusetts Institute of Technology to be graduated with honors in both civil and sanitary engineering, died in Baltimore, Md., Feb. 20. Employed for many years by the N. Y. State Department of Highways, he invented a number of paving machines and developed paving processes used on the Long Island parkways and at the New York World's Fair.

Philip E. Marvin, 45, New Castle, N. H., civil engineer, died Feb. 23 at Providence, R. I. He began his career with the New Hampshire State Highway Department, and then joined Warren Brothers, Cambridge, Mass., road builders. He worked for the War Department on construction projects in the south and during the war he specialized in airport work at Baranquilla, Colombia, and later supervised work of the same kind at Dow Field, Bangor, Me.

E. Hall Faile, 63, an engineer who supervised the construction of a number of N. Y. City buildings, died at Hobe Sound, Fla., Feb. 21. He was a graduate of Cornell University.

John Lanese, 29, engineer employed by Garloch Bros., Akron, Ohio, contractors, in construction of the Alliance water softening plant, died Feb. 18 in a railroad accident near Altoona, Pa.

Thomas Jefferson Smith, 70, Columbus, Ohio., civil engineer, died Feb. 21 in Miami, Fla. He was prominent in the public utilities field in New York and Cleveland. He organized and set up the Ohio Power Co., was associated with the American Gas and Electric Co., and later was with Midwestern Utility Co.



As Reported this week to . . .
Engineering News-Record

CONSTRUCTION ACTIVITY

CONTRACT VOLUME

**Continental U. S. Only
(Thousands of Dollars)**

	Week of Mar. 6 1947	Cumulative 1947 (10 wks.)	Cumulative 1946 (10 wks.)
Federal	$4,796	$76,741	$72,451
State & Mun.	22,479	229,513	139,054
Total Public.	$27,275	$306,254	$211,505
Total Private	100,596	609,078	453,166
U. S. Total..	**$127,871**	**$915,332**	**$664,671**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1947 (10 wks.)	Cumulative 1946 (10 wks.)
Waterworks	$969	$20,037	$10,744
Sewerage	825	16,781	7,278
Bridges	5,142	27,768	17,099
Highways	12,615	88,499	74,299
Earthworks, Waterways	1,869	23,782	39,357
Buildings, Public	3,333	85,230	48,281
Industrial	22,371	157,280	195,519
Commercial ...	24,908	350,834	225,014
Unclassified	55,839	145,121	47,080

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1947 (10 wks.)	Cumulative 1946 (10 wks.)
NON-FEDERAL	$208,100	$156,869
Corporate Securities	20,195	67,004
State and Municipal	187,905	89,865
FEDERAL	......	158,320
Total Capital	**$208,000**	**$315,189**

ENR INDEX NUMBERS

Index Base=100		1913	1926
Construction Cost..	Mar.'47	391.93	188.40
Building Cost	Mar.'47	298.82	161.53
Volume	Feb.'47	197	86

EDITORIALS

VOLUME 138 NUMBER 10

March 6, 1947

High Capacity Highways

NON-STOP HIGHWAYS into the hearts of cities supplementing expressways around and between them provide the only feasible way to handle increasing road traffic in congested regions. That is the outstanding conclusion to be drawn from the discussion at the meeting of the Association of Highway Officials of the North Atlantic States, reported in this issue. Officials most concerned with traffic movement along the North Atlantic seaboard are agreed that capacity and safety can be economically achieved only by eliminating intersections as we now know them—to be replaced with facilities for vehicles to enter the traffic stream only in channelized flow. Cost per mile of such road will seem excessive, especially under current conditions as compared with costs during the depression years. But the proper measure of cost is vehicle capacity and safety. By such standards costs are justifiable, and it is on this basis that expressway program should be presented to the public.

New Sphere of Interest

WE PUBLISH in this issue an authoritative account of what the Pauley Reparation Commission found in Manchuria, not because of the light it throws on the reparations and foreign relations problems, but to draw the attention of American engineers and construction men to an area that may be of more interest to them than they realized. You think a job in Manchuria is too remote a possibility? Many who thought the same about Persia, India, Afghanistan, Saudi Arabia, Palestine and Liberia now find themselves temporary inhabitants of those countries. Since the war, American construction men have been dropped on new and far flung frontiers as never before. Manchuria, as the article clearly shows, may well be the next of these frontiers to be added to the list. It is not, as some may think, a wild and undeveloped country. Although once aptly labeled the "cradle of conflict," and at present living up to the label, it is both a bread basket and a pot of gold—and of coal, iron and molybdenum too. Moreover, it and neighboring Korea comprise the only truly industrialized area in the Far East, outside of the Japanese Islands. Steel plants, textile mills, aluminum plants, more railroad mileage and more hydro power than in the whole of China proper are some of its assets. Much of this has been damaged and destroyed. It must be rebuilt. It will be added to, for Manchuria is much too rich and strategic a country not to attract development capital and American construction talent. Before many years have passed such city names as Mukden, Changchun, Antung, Anshan, Fushun, Kirin and Harbin, and the names and locations of such rivers as the Yalu, Amur and Liao will and should be a part of every informed engineer's education.

A Good Start

PLANS for a second traffic artery across San Francisco Bay were moved a long step forward by the recent report of the joint Army-Navy board of engineers (*ENR* Feb. 13, 1947, vol. p. 237). By recommending both a specific location and a specific type of crossing the board rendered a high order of service; in a situation already surfeited by proposals, a non-committal or hedging report would only have compounded confusion. Not the least of the service rendered by the report is its reversal of previous military pronouncement that "no permit will be granted for any low-level bridge north of Hunter's Point."

Close on the heels of this joint report comes the recommendation of the California Department of Public Works, which favors making the new crossing another high-level structure close to the existing bridge (*ENR* Feb. 27, 1947, vol. p. 345). Such a location has the advantage of maximum relief for the present bridge bottleneck with the flexibility and increased capacity to be had by temporarily making an entire bridge available to one-way travel during peak traffic in either direction.

In the preparation of this latter report, the problem of meeting present and future needs was handled by men with an exceptional background of experience. They have already bridged the bay once; their specialty is providing for California highway traffic and it would be hard to find more competent opinion.

Hence both reports represent careful and conscientious work by competent engineers; both have been received with respect and admiration. The tube and trestle crossing should present no unprecedented design or construction problems and in the location proposed would be a great advantage to a section of San Francisco capable of extensive development. Alameda, bypassed by the present bridge, would be ideally served by this proposed location which also would bring an additional bridgehead to Oakland.

Thus there are arguments for both recommended locations. Though considerable detail study will be required before final decision could be expected, the air has been cleared materially by screening the many possibilities down to two carefully considered and well-supported proposals. Having done this, there is something definite to study and to compare, which is precisely what was needed.

Consolidation by Vertical Drains

NEARLY fifteen years ago when the present bridge over San Francisco Bay was being built, the soft material underlying the fill for the east approach was successfully consolidated by the use of a method proposed by O. J. Porter of the California Division of Highways. Briefly, the method consists of excavating numerous vertical holes through the soft material, usually by jetting down large pipes, and filling the holes with porous sand. These vertical drains permit moisture to flow out of the soft material and rise into a horizontal bed of coarse material laid over the surface of the ground on which the new fill is to be built. By this means, consolidation of the deep silt bed that normally would take years is accomplished in a few months. During the war this method was used successfully for several highway and Navy projects in California and now it is being applied to two big freeway fill jobs, one of which is described in this issue.

There is much novelty in this method of soil consolidation, and yet like most engineering developments, its antecedents go back many years. In this case it may be said that they go back 75 years to early crude efforts to increase the output of driven wells, which resulted in the gravel-pack wells of today. More recently, about 1922, the late Daniel E. Moran patented a process of soil consolidation by pumping from sand-filled wells while further sand was tamped into the wells and piles were driven into the adjoining soil to compress it laterally. Mr. Porter, who has contributed so much to the current development, says that Mr. Moran's work and the writings of Karl Terzaghi had an influence on his thinking about the possibility of rapidly consolidating mud and other compressible ground.

Therefore, not the least interesting aspect of the work described in this issue is its evidence of the continued employment of the best thinking of many minds. For example, specifications for the current work prepared by the California Division of Highways did not stipulate how the vertical sand drains were to be formed; responsibility for that was placed on the contractors, the Macco Construction Co. and the James I. Barnes Construction Co. As a result two quite different methods were evolved that already have shown the advantage of making the widest possible use of the practical knowledge of the contractors.

Contractors' Construction Costs

WHAT does it actually cost to build a mile of highway? This question has baffled engineers and contractors alike for the past year or more. Determined to find out just what constitutes the actual cost of construction, the Missouri State Highway Department is making a detailed cost analysis of one of its typical heavy-grading, concrete-pavement construction projects. As described elsewhere in this issue, the cost-keeping method involves daily records of labor, materials and equipment used in the construction of nearly 100 contract items included in the projects. Overhead and office expenses of the contractor are not overlooked as they constitute an important factor in the study.

Much can be said in favor of making such a construction cost analysis — from the standpoint of both the engineer and contractor. It will be an invaluable aid in analyzing future contract bids on similar work; in determining agreed contract prices; and in the preparation of engineers' estimates. For the contractor however, such a cost analysis should be even more beneficial. It will show him in detail just where his money is going and so will make it possible for him to determine what part of the cost of a job should be allocated to overhead and office expenses. He also will be given a means for evaluating the efficiency of labor and the productivity of individual units of construction equipment.

ENGINEERING NEWS-RECORD
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Navy-Built Aqueduct for San Diego

***Editor's Note**—Fear of an acute water shortage in the San Diego area because of increased civilian, military, and industrial demands prompted authorization of the wartime construction by the Navy of a 71-mile aqueduct. First contracts had been let when the war ended and the intended cancellation of the project was announced. Subsequently an arrangement was made whereby the Navy would complete for the city the construction already planned. Major work consists of laying reinforced concrete and steel pipe and tunneling. Other features of the project are inverted siphons designed for heads as high as 930 ft. and high density compaction in backfilling pipe trenches. Improved methods of concrete pipe manufacture and the methods employed in lining tunnels will be described in forthcoming articles.*

UNDERTAKEN as a wartime measure, construction on the San Diego aqueduct had been scheduled for cancellation in September, 1945, when arrangements were made for the Navy to complete the project for the city. As now being built and on a program scheduled for completion late this year, the aqueduct will connect the San Diego water-supply system with the system serving cities in the Metropolitan Water District of Southern California at the outlet portal of the San Jacinto tunnel of the Colorado River aqueduct.

Principal features involved in constructing the tunnels and the reinforced concrete and steel pipeline which comprise the 71-mile aqueduct are: Siphons operating under heads as high as 930 ft., improved methods of making concrete pipe and of placing concrete in tunnels, and a pipe-laying procedure in which parts of the backfill are compacted to 98 percent of maximum laboratory density. Significant quantities involved in addition to those shown in Table I are as follows: Excavation—2,850,000 cu.yd., backfill—2,100,000 cu.yd., and concrete in structures (not including pipe concrete)—135,000 cu. yd.

Much has been said regarding the need for additional water in all sections of the Southwest. The ultimate need for Colorado River water in the San Diego area is a generally accepted fact. Statistics of the San Diego County Water Authority show that in the coastal slope area of the county the demand for water at this time is 119,000 acre-ft. a year, the present developed local sources produce a net safe yield of 96,000 acre-ft. a year and the estimated probable net safe yield of all local sources is 140,000 acre-ft. a year.

According to these figures, the present supply is overtaxed by some 23,000 acre-ft. a year or about 25 percent. Additional development of local sources was not considered to be solution to the problem because: (1) long periods of drought make local supplies undependable; and (2) even after construction of required facilities a year of good runoff is required to fill reservoirs. The aque-

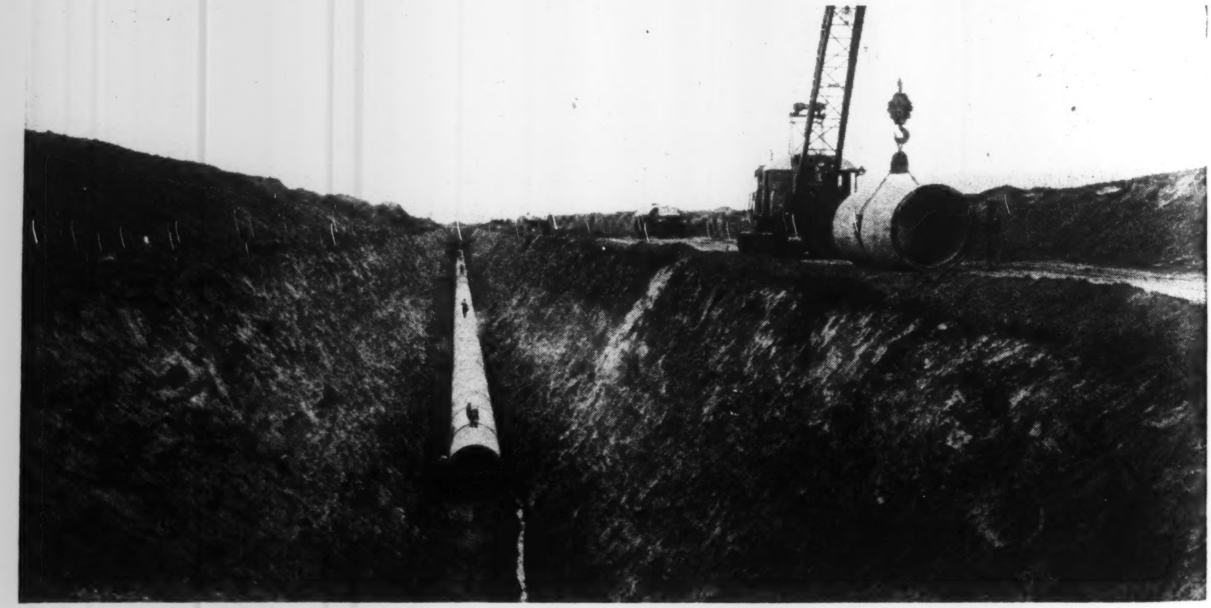

Fig. 1. Typical of much of the construction on the San Vicente aqueduct is the placing of 72-in. dia. concrete pipe in trench some 32 ft. deep. Heavy cut was required at this location to get pipe down to the hydraulic gradient line.

duct now under construction is planned to make up the deficit in safe yield and also to provide for additional future expansion. Further local development will be undertaken in the future, if needed, but local sources will probably never be developed to ultimate capacity.

Both the city and the county have long been contemplated making Colorado River water available to this area. As early as 1926, the city made application to the California Division of Water Resources for the right to divert 155 cfs. (112,000 acre-ft. per year) from the Colorado River. In 1933 a contract for Colorado River water was entered into between the Secretary of the Interior, Ray Lyman Wilbur, and the city and approved by county officials. This contract provided for storage at Boulder Dam and for delivery above Imperial Dam on the Colorado River. It also provided that if the city did not take or divert water within a period of 10 years following the completion of Boulder Dam, the contract would be void. The 10-year period expired in 1946, and the construction now under way will satisfy this contract provision. Had the Navy not continued with the work, it is doubtful whether the city would have been able to get the project under way soon enough to meet this contract deadline.

All-American Canal route studied

Preliminary investigation of possible routes for bringing Colorado River water to San Diego made by the city indicated a preference for a route over the mountains east of the city, connecting with the All-American Canal. A contract entered into in 1934 by the Bureau of Reclamation and the city stipulated that additional capacity will be provided in the All-American Canal project for the diversion and carriage of San Diego's water. In 1943 city and county officials entered into a contract with the bureau for surveys and reports which would afford a comparison of the All-American Canal route with one connecting the Colorado River aqueduct of the Metropolitan Water District with the city's San Vicente reservoir.

Before these comparisons could be completed and under the impetus of wartime conditions, San Diego's civilian, industrial and military growth was such that it was feared that the existing water supply would be overtaxed and war activities in the area might have to be curtailed. During some war years, Federal agencies used more than 40 percent of the water which the city supplied to users.

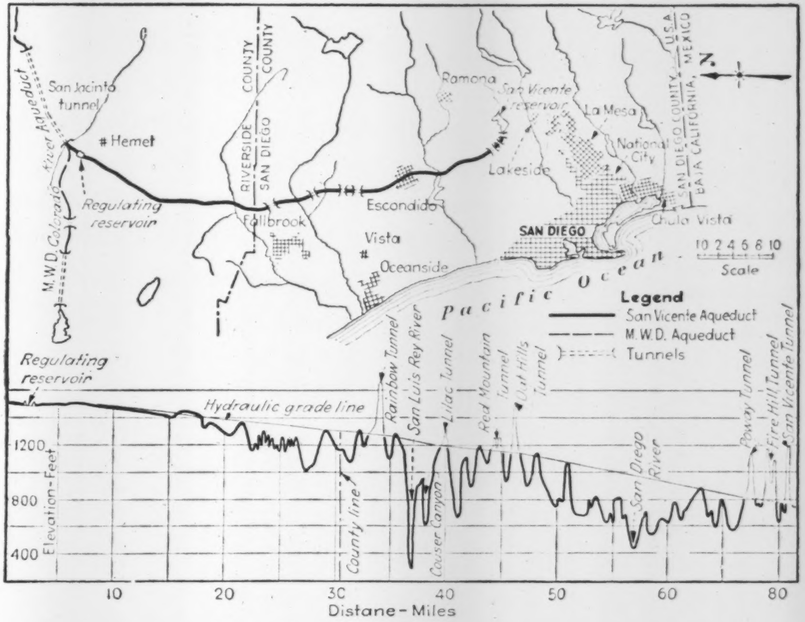
San Jacinto tunnel
Hemet
M.W.D. Colorado River Aqueduct
Regulating reservoir
RIVERSIDE COUNTY
SAN DIEGO COUNTY
Fallbrook
Escondido
Vista
Oceanside
Ramona
San Vicente reservoir
Lakeside
La Mesa
National City
SAN DIEGO
Chula Vista
U.S.A.
MEXICO
SAN DIEGO COUNTY
BAJA CALIFORNIA
N.
10 2 4 6 8 10
Scale
Pacific Ocean
Legend
San Vicente Aqueduct
M.W.D. Aqueduct
Tunnels
Regulating reservoir
Hydraulic grade line
Rainbow Tunnel
San Luis Rey River
Lilac Tunnel
Red Mountain Tunnel
Out Hills Tunnel
San Diego River
Poway Tunnel
Fire Hill Tunnel
San Vicente Tunnel
County line
Couser Canyon
Elevation-Feet
1200
800
400
10
20
3C
40
50
60
80
Distane-Miles

Fig. 2. Except for the first few miles, most of the aqueduct goes through rough terrain as can be seen in the accompanying plan and profile. This gravity flow route required several tunnels and deep siphons.

As an emergency measure the President of the United States in October 1944 appointed a committee to study the problems involved in financing and constructing facilities for increasing the water supply. This committee included representatives of various agencies as follows: For the Bureau of Reclamation, William E. Warne, chairman; for the War Department, Lieut.-Gen. Eugene Reybold; for the Navy Department, Vice-Admiral Ben Moreell; for the Federal Works Agency, Baird Snyder; and for the San Diego County Water Authority, Phil D. Swing.

Studies by the Bureau of Reclamation being made for the city were not completed. However, a preliminary report on the San Jacinto-San Vicente route was made available to the committee. A decision by the committee in favor of this route was made, even though it is longer than the All-American Canal route, because: (1) only two years were required to complete it; (2) it is an all-gravity flow route and thus does not require heavy electrical equipment or other similar war critical materials such as would be required where pump lifts were involved; and (3) no long tunnels are necessary (longest tunnel is the 5,350-ft. Fire Hill Tunnel whereas the most favorable All-American Canal route—the so-called Banner Route—includes a 7.5 mile main tunnel). The wisdom of the decision is believed to have been subsequently confirmed by data made available by reports of the Bureau of Reclamation and by independent analysis of local authorities.

Government financing construction

The recommendations of the committee on the route and financing were accepted by the President. The cost was prorated between the Navy Department (70 percent), the War Department (10 percent), and the Federal Works Agency (20 percent). The Navy, which had the greatest interest of any of the federal agencies in the project, was authorized to build the project. Final plans and specifications were prepared by the Bureau of Reclamation and turned over to the Navy. A small force of bureau employees was retained on the project in a consulting capacity to the Navy on the construction program.

Initial contracts had been let when termination of hostilities caused the cancellation of many Navy projects. However, San Diego city officials were anxious for the Navy to complete the project because: (1) the Navy had favorable contracts let—more favorable than the city hoped to get in the future; and (2) the city felt that the water need would still be acute and, as eventual construction was planned anyway, the city wanted the Navy to continue so that water might be available before local supplies were depleted.

Therefore, an arrangement was made for the Navy to complete construction with the city agreeing to pay the federal government an annual rental of $500,000 starting three months after completion of construction and continuing until the estimated $15,000,000 cost to the government is paid. At 5-year intervals the city will have the option to purchase the aqueduct for a lump sum. In effect, the government is making the city an interest-free loan.

At the time this was written, hearings were being held before a board consisting of representatives from the various interested federal agencies to determine whether the federal government still had an interest in the project and should bear part of the cost. Personnel on this committee is as follows: For the Bureau of Reclamation, William E. Warne; for the Navy Department, Rear-Admiral J. J. Manning; for the War Department, Brigadier-General R. C. Crawford; and for the Federal Works Agency, George H. Field.

Water authority to administer

The San Diego County Water Authority, formed in 1944 and consisting of the cities of Coronado; Chula Vista; National City; Oceanside; and San Diego and also including the Fallbrook Public Utility District; the Lakeside Irrigation District; the La Mesa, Lemon Grove and Spring Valley Irrigation District; and the Ramona Irrigation District, will administer the aqueduct as a member agency of the Metropolitan Water District of Southern California. (Coronado and Ramona Irrigation District have withdrawn from the authority since it was formed.)

Annexation to the Metropolitan Water District was authorized at the Nov. 5, 1946, election when the people voted to assign the city's contract for constructing the aqueduct to the water authority and also approved the annexation of the authority to the district. The water authority will have to pay the district the sum of $13,045,000 over a period of 30 years. This is to cover the authority's prorated share of the approximately $190,000,000 cost for the Colorado River aqueduct. The payment also includes $300,000 for power loss at Parker Dam (San Diego's water was to have been taken from the Colorado River at Imperial Dam). The government power loss will be replaced by district power.

Under this plan, the water rights of the city and the county of San Diego will be merged with the rights of the Metropolitan Water District. This is considered to be beneficial to all concerned as under this plan only one agency will be taking water from the Colorado River for use in parts of California not located in the Colorado River Basin. This program, also, will allow for greater flexibility of operation of the Metropolitan Water District.

TABLE I—LENGTHS OF MAIN SECTIONS OF SAN VICENTE AQUEDUCT

Type	Size (in.)	Design capy. (sec.-ft.)	Length (ft.)
Tunnel	72	165	23,235
Regulating reservoir	..	...	3,085
Reinf. conc. pipe	96	200	10,645
Reinf. conc. pipe	72	165	17,382
Reinf. conc. pipe	72	85	48,092
Reinf. conc. pipe	54	85	114,734
Reinf. conc. pipe	48	85	148,976
Steel pipe	48	85	9,263
			375,412

TABLE II—SCHEDULE OF CONTRACTS—SAN VICENTE AQUEDUCT

Description	Contractor	Length (miles)	Contract Amount	Percent Complete Jan. 1, 1947
Reservoir and pipeline	Guy F. Atkinson Company	2.6	$1,164,885	100
Pipeline	*Concrete Pipe Constructors	19.1	2,248,409	95
Pipeline	United Concrete Pipe Corp	21.6	3,585,089	20
Pipeline	S. A. Healy Co (J. S. Barrett)	21.7	2,597,344	75
Rainbow, Lilac, Red Mountain, and Oat Hills Tunnels	S. A. Healy Co (J. S. Barrett)	2.2	874,218	65
Poway, Fire Hill, and San Vincente Tunnels	W. E. Callahan Const. Co. & Gunther & Shirley Co.	2.1	878,536	65
San Luis Rey River, Couser Canyon, and San Dieguito River siphons	J. E. Haddock Engineers, Ltd.	1.8	640,856	100
Fabrication of joint ring assemblies	American Pipe and Construction Co.	....	586,893	..
Totals		71.1	$12,576,230	65

* Concrete Pipe Constructors is a joint venture of Grafe-Callahan Const. Co., Gunther & Shirley Co., Condon-Cunningham Co., and Gibbons and Reed Co.

Ultimate capacity 165 cfs.

As already stated, the San Diego area has the right to the equivalent of 155 cfs. of Colorado River water. A capacity of 165 cfs. was used in designing the aqueduct to allow for interruptions in flow caused by power failures, breaks in the line, necessary repairs and the like.

The President's committee in 1944 recommended that the line to be constructed under emergency wartime conditions have a capacity of 85 cfs. It was felt that this was sufficient to take care of the existing need and, being approximately half of the ultimate capacity, a parallel line could be installed to raise the capacity to 165 cfs. Thus, the aqueduct now under construction has a capacity of 85 cfs. except that tunnels and other permanent structures were designed for a capacity of 165 cfs. (Table I). To facilitate construction, the tunnels are being built with a somewhat larger capacity.

Some believe that the construction of parallel facilities will entail many difficult construction problems. Building a large reinforced concrete pipeline within a few hundred feet of an existing pipeline with the use of blasting and heavy equipment, it is suggested, may involve damage to the existing line. No estimate has been made regarding the date when the increased capacity will be needed.

Because of the terrain through which the line travels, open canal construction was not found to be economical. Most of the aqueduct consists of reinforced concrete pipe provided with bell and spigot steel joint ring assemblies that are sealed with synthetic rubber gaskets when laid. Cement motar is placed in the space remaining to further seal the joint and make the pipe smooth both inside and out.

The pipe varies in size according to location, the smaller sizes (48 and 54 in.) being placed on the steepest slopes and the larger sizes (72 and 96 in.) being placed on flatter slopes and in permanent sections designed for full capacity. The 72- and 96-in. pipe are designed as open-flow pipe (i.e. under no pressure).

Reinforcing varies from nominal for pipe placed near the hydraulic grade line to heavy for sections subject to heads varying up to 500 ft. Reinforcing consists of 7/16 to 7/8-in. wire spirally wound into circular cages as is typical of this type of construction. For a pipe requiring heavy reinforcing, the inside of the two cages is wound around a steel cylinder the size of which varies in thickness from 14 gage to 7 gage. Reinforced concrete pipe was made using concrete with a maximum slump of 4 in. and averaging 2½ to 3 in. To work this stiff mix into the forms, pipe manufacturers developed improved methods, which will be described in a forthcoming article.

Regulating reservoir

From the diversion structure at the outlet of the San Jacinto Tunnel, a 96-in. diameter pipe extends for some two miles to a regulating reservoir. The capacity of this pipe, which is 200 cfs., was made larger than the remainder of the aqueduct in order to take the discharge of one set of pumps on the Colorado River aqueduct. In addition to an operator's house, the diversion structure includes three 6.4x8.0-ft. motor-operated control gates and venturi and float gage measuring devices.

The regulating reservoir has a total capacity of some 1,850 acre-ft. and consists of a rolled earth embankment around a relatively flat 150-acre area. The reservoir site varied in elevation some 15 ft. from low point to high point. It was first stripped of some 10 in. of top soil to clear away vegetation, root structures and other pervious materials that might permit water seepage. The upper half of the area was leveled and the spoil from the stripping and leveling became the core of the dike that surrounds the reservoir. The lower half was graded to remove irregularities.

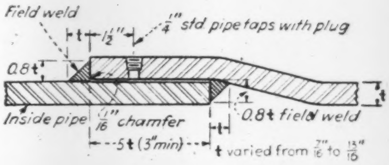

Fig. 3. Welded steel pipe, used in siphons where the head exceeds 500 ft., was provided with a space at the joint for testing purposes.

The soil at this location is of a sandy, pervious nature. Therefore, impervious material was brought in and spread in a compacted blanket some 12 in. thick over the bottom of the reservoir area and over the face of the dike; the latter is made up from the material excavated from the reservoir bottom. The dike was then covered with a layer of 12 in. of tunnel muck obtained from the San Jacinto tunnel spoil. This material consists of irregular particles of granitic origin and was used to protect the dike from weathering and burrowing animals. The interior face of the dike was then covered with 2 ft. of rock riprap to further protect it from the action of the reservoir water.

Fig. 4. After the steel pipe was placed, welded, and tested, the outside of each joint was coated with gunite.

The outlet structure of the regulating reservoir contains valves and venturi meters to control the aqueduct flow. There are no other control valves for the remaining 69 miles of the aqueduct. However, some 200 other structures such as manholes, blowoff valves, service outlets, air vents, risers, tunnel connections, and bifurcation structures are provided where necessary for the protection and operation of the aqueduct.

Heavy compaction for backfill

In excavating trenches preparatory to laying the pipe, one of two methods was followed depending on whether the trench bottom was in earth or in rock excavation. In earth, the trench bottom was cut to the exact shape of the pipe except for bells cut out at the joints. When the line went through rock, the trench was overexcavated a minimum of 12 in. and select backfill was compacted to 98 percent density on the bottom to fit the shape of the pipe.

After the pipe was placed, backfill around it up to just below the springline of the pipe was compacted to 98 percent of maximum laboratory density. Such compaction was very difficult in the narrow trench space in which the work had to be done. On relatively level stretches, pneumatic hand tampers on slightly moistened soil proved to be the most satisfactory compaction method. On steeper slopes various combinations of puddling, flooding, and jetting and poling were tried and, although the desired results were achieved, no outstandingly satisfactory method was developed.

Steel pipes for high heads

Three sections of the line where the head is greater than 500 ft. are constructed of 30-ft. lengths of steel pipe. Although many concrete pipe sections of the line are laid as inverted siphons the three steel pipe sections are the only parts of the line called siphons (San Luis Rey, Couser Canyon and San Dieguito siphons).

The steel pipe was coated inside

and out with coal-tar enamel and a cement-mortar coating was added on the outside. Some 9-in. were left free of coating at each end of the pipe to facilitate welding. After field welding, the joints were enameled and the outside was covered with gunite.

The thickness of the steel varies from 7/16 in. up to 13/16 in. depending on the head to which the various sections are subjected. The pipe is constructed with a bell and spigot joint so fabricated that the inside circumference of the bell is not more than ⅛ in. greater than the outside circumference of the spigot. The joints are welded inside and out (Fig. 3) and were subjected to a soap bubble air pressure test by means of pipe taps in the bell part of the joint. Air pressure at about 100 psi. was introduced into the space between bell and spigot. A soapy solution was used for spotting leaks.

The San Luis Rey siphon has a head of some 930 ft. and is also noted for its steep slopes which vary from 35 to 65 percent for the 1,000 ft. of pipe length leading to the floor of the canyon. These slopes made pipe laying and backfill compaction difficult and also presented problems in connection with the pouring of concrete anchor blocks required as protection against thrust at bends in the line. Backfill on these slopes is compacted as described in the foregoing and protected with riprap to prevent its washing away.

Tunnel construction

In calling for bids for construction of the various tunnels on the project, three alternative horseshoe sections were allowed—7 ft., 6 ft., or 4 ft. 8 in. As the 6-ft. section cost only slightly more, than the 4-ft. 8-in. section and permitted better construction methods, it was adopted. Tunnels were driven by conventional methods. New tunnel lining methods were developed and these will be described in a forthcoming article.

The outfall of the aqueduct will be at the San Vicente reservoir, which is part of the San Diego city water supply system located some 20 miles northeast of the city. Additional facilities for supplying the water to member agencies of the San Diego County Water Authority are yet to be constructed. The city of San Diego is also planning on building a softening plant to treat the Colorado River water which averages around 400-ppm. hardness.

During the years of planning on this aqueduct project, many engineers have contributed a great deal to the plans as ultimately adopted. Engineers representing the various agencies in the final planning stages are as follows: For the Navy, Capt. A. K. Fogg, CEC, USN; for the city of San Diego, Fred D. Pyle; for the San Diego County Water Authority, J. L. Burkholder; and for the Bureau of Reclamation, R. B. Ward. Actual construction is under the direction of Captain Fogg as public works officer, 11th Naval District, and Comdr. R. D. Thorson, CEC, USN, resident officer in charge of construction.

State Agency on Control Surveys And Mapping Urged for Ohio

Confusion and inadequacy of control surveys and mapping indicates a need for a state-wide agency to coordinate, collect and furnish the latest available information for the use of all concerned, according to an article appearing in a recent issue of the Ohio State University "Engineering Experiment Station News". Authors of the article are O. J. Marshall, professor of surveying and geodesy at the university, and M. T. Jones, consulting engineer of Columbus, Ohio. How such an agency could be set up in Ohio is told in the article.

A step toward the proper system for horizontal control of all maps, according to the authors, was taken last year when the Ohio legislature adopted the Ohio Coordinate System as established by the U. S. Coast and Geodetic Survey. This is a step in the desired direction. However, it is claimed that in order to serve its intended purpose this legislation should now be implemented and extended by additional control surveys and mapping properly coordinated and administered by an agency set up for that purpose.

It is suggested that this Bureau of Surveys and Maps might well come under the state public works department, and that it is desirable to institute the bureau soon enough to provide necessary control data on a basis that will serve many other purposes as well as that of control for statewide maps. In this way duplicate surveys and additional expense could be avoided in the extensive mapping projects foreseeable as a result of increasing demands for better maps.

Among the functions of the proposed bureau would be:

1. Gather and permanently file copies of all maps of the state or portions of it which may be expected to be of value for reference.
2. Collect and permanently file records of all monumented points established to form the statewide survey control system both horizontal and vertical.
3. Acquaint the many agencies doing surveying and mapping work within the state with the presence of and the uses that may be made of the information on file.
4. Furnish information in regard to control monuments and supply copies of available maps at the cost of reproduction.
5. Prepare, adopt and promote the use of standard specifications for surveying and mapping of various classes.
6. Serve to coordinate the efforts of the many agencies making surveys and maps within the state in order to avoid duplication of effort.
7. Expand or elaborate the federal survey control systems so that the frequency of control points throughout the state will ultimately be closely related to expected need for maps in each region.
8. Establish and maintain control survey points determined by the personnel of the bureau or derived from other surveys.
9. Foster and assist in the training of selected members of other qualified agencies desiring to cooperate with and supplement the work of the bureau.

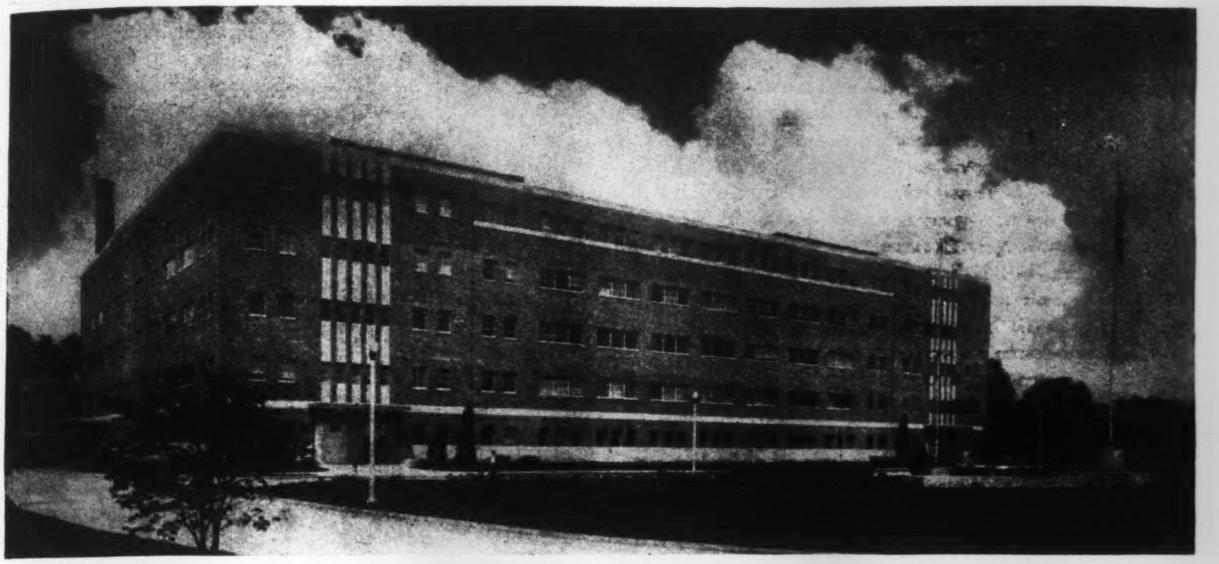

Fig. 1. Measuring 220x300 ft., the new Army Map Service Building is free of light courts and is air-conditioned throughout.

Army Map Service Gets a New Home

Contents in Brief—*To meet the present-day needs of map-making work, with emphasis on the methods developed during the war, a five-story concrete-frame building completely air-conditioned with close control over both temperature and humidity was constructed for the Army Map Service. The drafting rooms and other areas requiring good lighting were locoated in the outside portions, while the file rooms and similar space requiring no daylighting were placed at the center of the building. The distribution ducts for the air-conditioning and heating systems were built of sheet aluminum alloy, which proved to have major advantages.*

Recently the Army Map Service moved into a new home in Washington, D. C., designed specifically for the special problems met in mapmaking. The structure is considered the only building of its size planned primarily for housing map production operations utilizing the latest methods and equipment developed during the war.

The Army Map Service is an important division of the Corps of Engineers and is responsible for most of the mapmaking operations of the entire War Department. In addition to the normal job of handling much of the normal map work for the War Department, the service also has the task of processing the extensive collection of maps captured by the American military forces during the war.

A building to house a staff of about 2,500 persons on a one-shift basis was needed. Basically, the building had to be planned to accommodate all the various steps in mapmaking prior to the actual reproduction of the map. These operations include: translation, research, geodetic studies, compilation, stereophotogrammetric operations, and drafting. The administrative staff of the Army Map Service and the large map library of the service were also to be accommodated. However, the actual reproduction of the maps and the storage and distribution operations are to be continued in an existing plant near the new structure.

All spaces in the new building devoted to the preparation and compilation of maps had to be completely air-conditioned with close control provided over both temperature and humidity. Lighting had to be excellent, effective disposal of the gaseous wastes from the special work areas was required, and the structure had to be sufficiently flexible to accommodate a moderate enlargement of one operation and reduction of another, if this proved necessary. In addition, completion of the building in nine months was necessary, which required that the layout be as simple and uniform throughout as possible to speed construction.

The final choice was for a 220x300-ft. building five stories in height with two large penthouses but no basement. Since many areas did not require daylighting, such as the map library, storage areas for captured documents, multiplex booths, photographic rooms, toilets and machinery rooms, these areas were grouped at the center of the building and light courts were eliminated. Inside the daylighted areas on all floors a wide corridor runs completely around the building with elevator lobbies at the north end and a service elevator lobby at the southwest corner. This arrangement resulted in a structure of nearly uniform cross section throughout and a minimum of exterior walls.

For maximum convenience for visitors, which are expected to be rather numerous, the administrative offices were placed on the ground floor of the building, along with some of the utility rooms to be described later. The second floor provides spaces for the editing of all the maps prepared, several large drafting rooms, the manuscript files and the technical services division. The third and fourth floors were planned much alike with offices and drafting rooms along the outside and the numerous multiplex booths at the undaylighted center of the structure. In addition to offices for the cardographic division, the fifth floor plan provides the large cafeteria required because of the isolated location of the new building.

Flat-slab construction used

The framework of the building consists of 20x20-ft. bays of flat-slab construction with the amount of reinforcing practically the same in each direction. To provide adequate space between the floor slabs for air-conditioning ducts and other conduits, and at the same time provide an 11-ft. clearance below the light fixtures, a 15-ft. floor height throughout the building was specified. The structure was planned to be of skeleton construction with no part of the main building being wall bearing. An evaluation of these conditions led to the conclusion that expansion joints would not be needed.

Field investigations revealed that the spread footings could be designed safely for a pressure of 8 tons per sq. ft. on the micaceous schist foundation soil. The five main floors were designed for a live load of 300 lb. per sq. ft., and the floor of the penthouses for a 100-lb. load and the roof for a 30-lb. snow load.

In keeping with the national emergency specifications in force for the design of reinforced-concrete buildings at the time the plans were being prepared, a working stress of 24,000 psi. was specified for the reinforcing steel in tension. The maximum allowable compression of the concrete in the extreme fiber in flexure was set at 0.45 of the ultimate strength of the concrete. A concrete with a 28-day strength of 2,500 psi. was specified for all concrete below the first floor and that above the fifth floor, while a 3,000-lb. concrete was designated for all work from the first to fifth floors inclusive. However, in view of the short construction schedule, in combination with the limited amount of plywood available for forms, once the concrete mixes had been worked out an additional bag of cement per cu. yd. was added to produce a concrete having a high strength in five or six days. The resulting concrete developed a 28-day strength of approximately 4,500 psi. and permitted some forms to be stripped in four days.

Use of a rich mix made with ordinary portland cement was considered more economical than the purchase of high-early-strength cement.

In addition to their direct loads, the exterior columns were designed to resist bending moments equal to the combined exterior negative moments in the column strip and the middle strip of an exterior panel. The interior columns were designed to resist, in addition to their direct loads, the bending moments produced by fully loading the floor on one side of the column when there is no live load on the floor on the opposite side of the column. In both interior and exterior columns, 60 percent of the moments described was assumed to be resisted by the columns below the floor and 40 percent by the columns above.

With this design, the basement

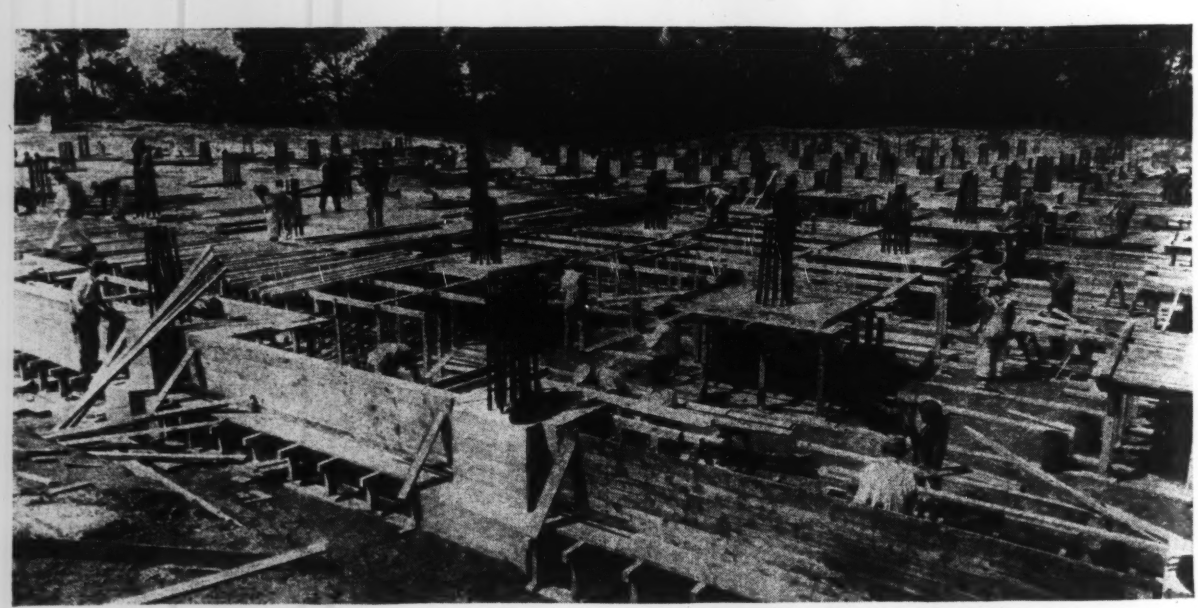

Fig. 2. In constructing the foundations, tractor-drawn carrying scrapers excavated to within about 1 ft. of the desired depth of the spread footings, hand tools then being used to complete the excavation. Once the footings and column pedestals were complete, the material removed by hand was spread uniformly by a bulldozer and the shoring for the first floor was supported on mud sills as at the left.

columns had to be 32 in. in diameter, while the typical interior column on the top floor is of 18-in. diameter. All the columns have mushroom heads of uniform diameter and 8x8-ft. dropheads 4 in. deep. The dimensions for the dropheads were made slightly larger than minimum design requirements to permit the forms to be fabricated from stock materials without cutting. For example, the areas between dropheads could be formed of standard 4x8-ft. sheets of plywood without any waste and the forms for each drophead could be made of two full-size sheets. Moreover, 2x4-in. timbers could be used for framing the 4-in. depth of the dropheads.

An exterior wall with good insulating characteristics and attractive in appearance was desired. The final choice called for a wall 16 in. thick consisting of 4-in. of red colonial brick with limestone trim, 8 in. of structural hollow tile, and 4 in. of cinder block furring. A large area of the exterior walls are given over to windows designed for a low heat transfer. The windows are 3/4 in. thick and consist of two 1/4-in. layers of plate glass separated by a 1/4-in. sealed airspace.

Most of the interior walls are of 6-in. thick cinder block. Exceptions are the glazed tile walls for the stairways, toilets, kitchen and cafeteria. Because of the acoustical benefits to be obtained, the exposed cinder block was not plastered, although it was painted. The only plastered walls are those in the fan rooms and the photographic laboratories.

To provide flexibility in dividing up the office area, 8-ft. high sub-partitions constructed of 4x8-ft. panels of plywood were specified. Maintenance forces can easily shift these sub-partitions whenever a change is desired.

Acoustical tile on ceilings

Preliminary plans called for use of a hung ceiling, but the shortage of many materials required that it be eliminated. Fortunately, the war ended when construction was well advanced and sufficient materials became available to permit an acoustical tile to be applied directly to the under side of the floor slabs, the tile being secured in place with mastic cement. Although the supports for the light fixtures and the various ducts were left exposed, the rooms have good acoustical characteristics and good appearance.

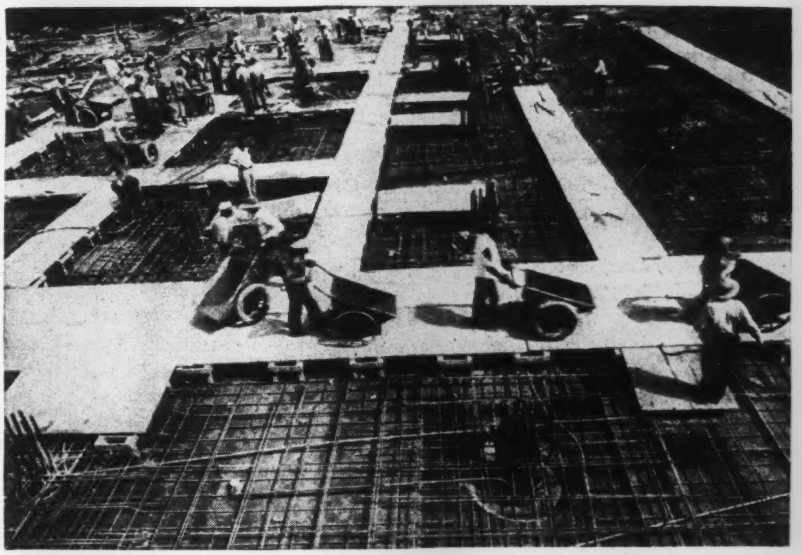

Fig. 3. Concrete for the framework of the building was delivered as transit mix, raised by a materials tower and distributed with buggies running over platforms laid for that purpose. Generally, one-quarter of one floor was constructed each day concrete was placed and a complete floor in two weeks.

Entire building air-conditioned

The entire building is air-conditioned throughout, both heating and cooling, by centrally located air systems zoned according to the orientation of the building. For map production operations it is essential that the moisture content of the air be maintained uniformly.

Heat for the air-conditioning work is supplied by three oil-fired boilers consisting of one 300-hp. unit and two 175-hp. boilers. The boiler room is located on the ground floor of the building near the service entrance at the southwest corner. Steam is distributed to the fan rooms at 40 psi., where pressure valves reduce the steam to 12 psi. for the kitchen equipment and to 2 to 5 psi. for the heating coils. The condensate flows by gravity to the storage receiver in the boiler room; the feed pumps operate automatically to maintain the desired water level in the boilers.

Chilled water is used as the cooling agent. It is supplied by two 500-ton centrifugal refrigeration machines located in the machinery room adjacent to the boilers. Heat from the refrigeration units is dissipated through an air-induced draft cooling tower located on the ground adjacent to the building.

The ventilating fans and the heating and cooling coils are located in four fan rooms. Two of these are located on the first floor and service the lower two floors. The other two fan rooms, which service the upper floors, are housed in the penthouses.

Special high-pressure exhaust ventilation is provided in each of the 229 multiplex booths, each of which measures about 8 by 8 ft. These booths are about evenly divided between the third and fourth floors. Individual exhaust ducts are provided for the single mapping machine in each booth. In being drawn from the room the exhaust air passes over the light bulbs of the mapping projector into a manifold and then into the building exhaust system. The air supply for each of the multiplex booths is furnished by the air-conditioning system for the building.

The kitchen space is ventilated at the rate of 30 changes of air per hour through hoods over the ranges and similar devices. Air for heating the kitchen is provided through ceiling grillages. To prevent cooking odors from spreading to other areas, the air delivered to the kitchen equals only 35 percent of the exhaust, the balance of the air being drawn from the cafeteria dining room and neighboring areas. To avoid chemical odors from the photo laboratories and the dark rooms from diffusing through the building, all conditioned air supplied to these rooms is exhausted by fan through openings in the roof. Replacement air for these areas is obtained from the corridors, where an excess amount of air is available from the conditioning system, since the corridors generally act as return air plenum chambers.

Aluminum used for ducts

Installation of the air-conditioning ducts was distinguished by the fact that they were constructed of sheet aluminum alloy, which was readily obtainable in contrast to the extremely critical supply of sheet steel. Various thicknesses of aluminum were used, dependent on the size of the ducts, with the predominant thickness 0.032 in. The resulting ducts were of pleasing appearance, which was considered desirable since they are exposed. In fabricating the ducts, somewhat greater care had to be exercised to prevent damage to the aluminum sheets than would have been necessary in assembling ducts of sheet steel. However, the aluminum alloy ducts could be installed much easier.

Electric power is supplied to the building by the Potomac Electric Power Co. over three 13.2-kv. feeders. The cubicle type switchgear, in which the three feeders terminate, is arranged for dividing each feeder into two sub-feeders. By this arangement each incoming feeder supplies one "power" and one "light" transformer. The six transformers are of the "network" type and each of 1,000-kva. capacity.

Two "spot" networks are formed by terminating the transformer secondaries on the buses of the main secondary "power" and "light" switchboards respectively. The object of this design was to guard against interruption to the building service in event trouble occurred on one, or even two, of the incoming feeders simultaneously. Failure of one feeder, which would automatically cause isolation of one "power" and one "light" transformer connected thereto, will have no effect on continuity of full-load operations. Fifty percent of full load may be carried satisfactorily even after failure of two feeders which, in turn, would cause isolation of two "power" and two "light" transformers from their respective networks.

From both the "power" and "light" switchboards 3-phase, 4-wire secondary feeders radiate to four symmetrical points in the building and then rise vertically to the fifth floor. These feeders are uninsulated copper bus bars, of standard size and suitable capacity, enclosed in steel troughs. Openings are provided in these troughs at each floor for the attachment of current take-off devices through which the various "power" and "light" distribution panels are fed. The many branch circuits for all purposes radiate from their respective distribution panels to the point of utilization. Separate sources for "power" and "light" insure constant voltage on the latter and thus eliminate any possible flicker of lights which would otherwise result due to voltage fluctuations when heavy power loads are energized.

Rigid conduit was used throughout the entire electrical installation. The minimum size conduit is ¾-in. dia. and no wire smaller than No. 12 gage was employed in wiring the many "power" and "light" circuits. Circuit breakers were installed throughout for protection of the various feeders, sub-feeders and branch circuits.

Fluorescent lighting fixtures are installed throughout the building except in corridors, multiplex booths, toilets, boiler and machinery rooms, where incandescent type fixtures were installed. The various processes relative to mapmaking required a design intensity of 50 foot-candles at the work level.

Other features of the electrical installation include a complete emergency lighting system, a fire alarm system, a watchman's report system, and public address and telephone systems. The cafeteria kitchen is completely electrified and the entire air-conditioning system is equipped with electric air cleaners.

The building has been completed and is now in use, the first office personnel moving in seven months after the foundation construction was started. To date the structure has proven highly satisfactory for housing the varied mapmaking operations now being carried out by the Army Map Service, for which Col. W. H. Mills is commanding officer.

Fred H. Hoch Associates, Inc., New York, developed the general floor plan for the building and firm of Porter and Lockie, Washington, D. C., was the architect-engineer for the project. John McShain, Inc., Philadelphia, Pa., was the general contractor. The work was done by the Washington district office of the U. S. Army Engineers for which Col. D. G. White was district engineer, Col. Byron Bird, executive officer, E. J. Merrick, Jr., resident engineer, and Dan M. Watt, project engineer.

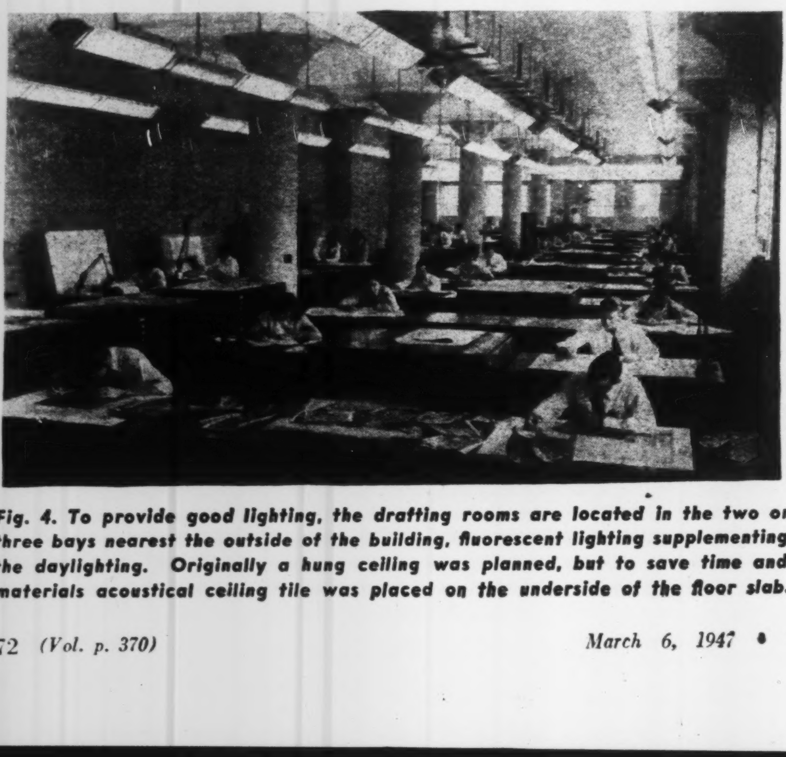

Fig. 4. To provide good lighting, the drafting rooms are located in the two or three bays nearest the outside of the building, fluorescent lighting supplementing the daylighting. Originally a hung ceiling was planned, but to save time and materials acoustical ceiling tile was placed on the underside of the floor slab.

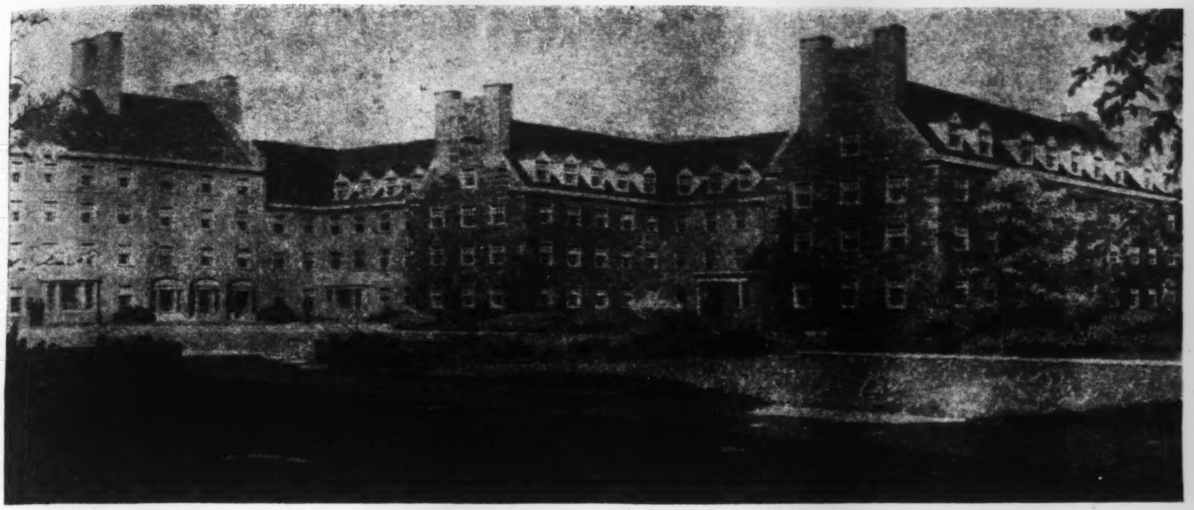

Fig. 1. Dormitory for 430 women at Cornell University utilizes local stone and brick bearing walls with steel interior frame.

Dormitory of Fire-Resistant Construction

Contents in Brief—*Metal joists, doors, frames, lath and a steel frame with masonry bearing walls keep fire hazard to a minimum in a dormitory for 430 girls at Cornell University. Of special interest is the use of left-in-place reinforced paper forms for poured floors and open-web joists for the roof.*

OPEN-WEB STEEL JOISTS play a particularly important role in making fire-resistant a dormitory at Cornell University, Ithaca, N. Y. The light weight, expanded joists carry each of the four floors through a wire and paper form supporting 2½ in. of concrete. Metal doors and frames, expanded metal studs and metal lath for plastered walls keep flammable materials to a minimum. A four-story Colonial type building in stone and brick, the dormitory will accommodate 430 girls, nearly all in single rooms, in a structure that is complete with kitchen, dining, reception and lounge rooms as well as recreational facilities.

The building partially surrounds a landscaped central area with all rooms outside. Architectural treatment combines local stone of the type used extensively in earlier college buildings with brick, which make a more economical wall to build. Window frames and sash, exterior doors, fenestration and cornices, are of wood to match the general colonial style.

Spread footings support the structure, which has a steel interior frame but utilizes the exterior walls for bearing. All field joints in the steel are bolted. Stone walls are 18 in. thick and brick walls are three bricks or 12½ in. Both types of walls are furred and metal lath is used to hold the plaster.

The open-web joists are 8 to 14 in. deep for varying spans and loads. Typical are 12 in. joists at 23 in. centers for a 20½-ft. span and 10 in. joists at 27 in. centers for a 14½-ft. span for normal dormitory loads. Two joists are used together where there is a partition above. In most instances, one end of the joist rests on the exterior wall and the other is carried on the structural frame. Diagonal bridging, similar to that used in wood joist construction is fastened by wire clips at about the third-points of each span.

Metal lath is hung directly under the bottom chord of the joists to carry a plastered ceiling. Designs call for

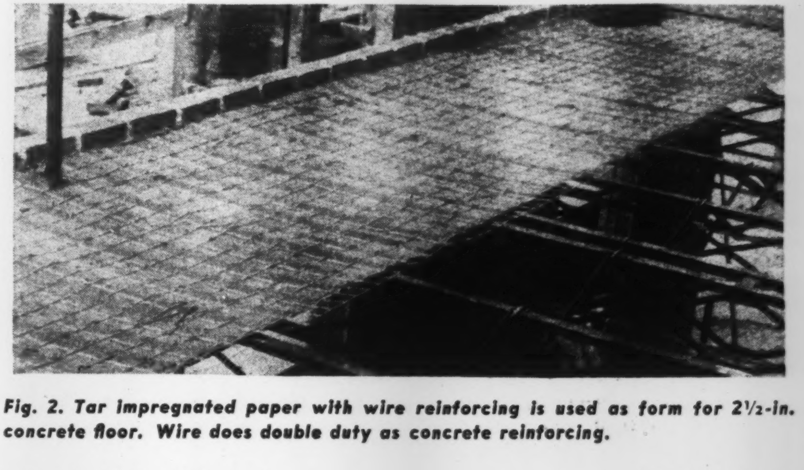

Fig. 2. Tar impregnated paper with wire reinforcing is used as form for 2½-in. concrete floor. Wire does double duty as concrete reinforcing.

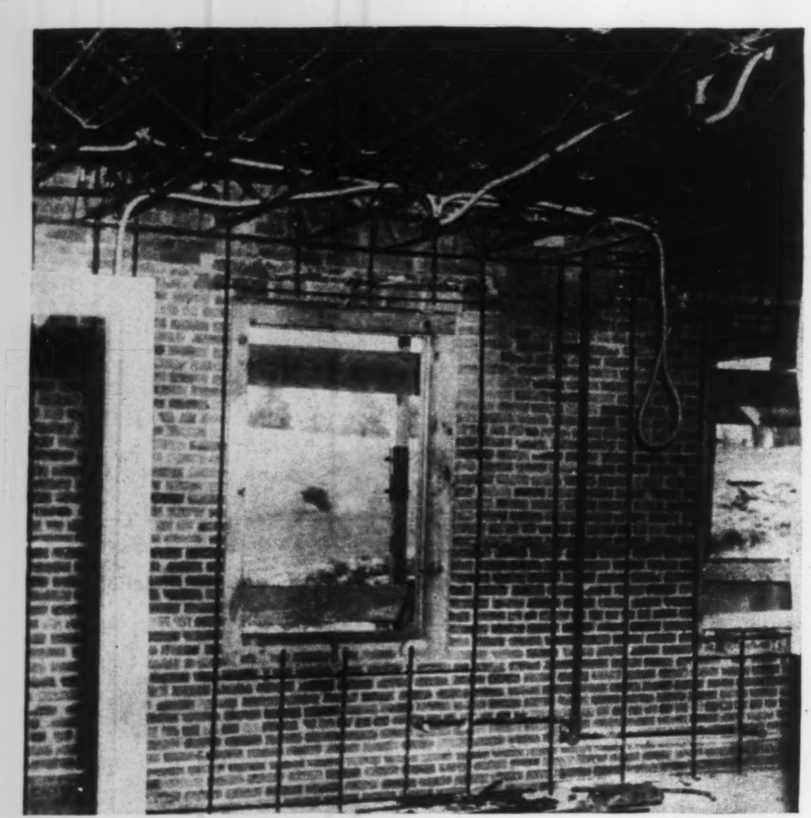

Fig. 3. The floor above this room has been poured over a wire reinforced paper form stretched over the joists shown in the upper part of this picture. The double joist is under a partition above.

running plumbing pipes through the open joists but, as a result of experience in doing that, the builders have concluded that running them below the joists would be more economical, even though additional vertical height of the building would be required.

A tar impregnated and burlap reinforced kraft paper with wire mesh serves as the form for floor concrete. A minimum 2-in. floor is required and the reinforced paper and mesh are stretched as tightly as is practical over bar joists spaced at 18 to 20 in. centers. The paper is drawn up tightly with a stretcher and fastened at the ends. It will support the weight of a workman but sags between joists so that concrete averages 2½ in. thick.

The wire mesh is mostly on top of the paper and is embedded in the concrete as the paper sags away from the wire, thus providing the only reinforcing used in the floor. Care must be taken when finishing to avoid movement of the concrete or any load on it after hardening has started as the monolithic structure of the concrete is disturbed and cracks will appear. For most of the building, concrete floors are covered with asphalt tile laid in mastic.

Rooms in the dormitory are generally about 9x14 ft., with closet, intended for one occupant. Baths and toilets are centrally located. There are some double rooms and a few suites, with bath, for use of supervisors.

Interior walls usually are 4 in. expanded metal studs with metal lath and plaster. Sound-proofing blankets 2 in. thick are used in some of the walls. Here, 3 in. metal studs are alternated from side to side of a wall 5 in. thick inside the metal lath with the absorptive material held in a serpentine curve.

Steel joists for peak roof

A most important use of the open-web joists is in the roof where 14 in. deep units at 2 ft. centers span 25 ft. on about a 1:1 slope. Where there are dormers two trusses are used at each side of the 4-ft. opening. Over the joists 2x16-in. tongue and groove concrete "nailing" plank 8 ft. long are laid and bolted to the joists. Slate is nailed to the plank, over 30 lb. felt, to provide the roof surfacing.

The job has suffered some difficulties in securing materials, but metal members, which were ordered some time ago, were on hand when needed. Wood instead of pipe scaffolding was used to avoid delay in wall construction. Old frame structures being demolished by the University were taken over to provide rough lumber.

While definite costs are not available, the contractor feels that the floor construction used saved one cent per square foot over comparable methods.

The structure was planned by Bagg & Newkirk, architects and engineers of Utica, N. Y. Construction was done by Barr & Lane, Inc. of New York City, for whom R. W. Gleason is general manager.

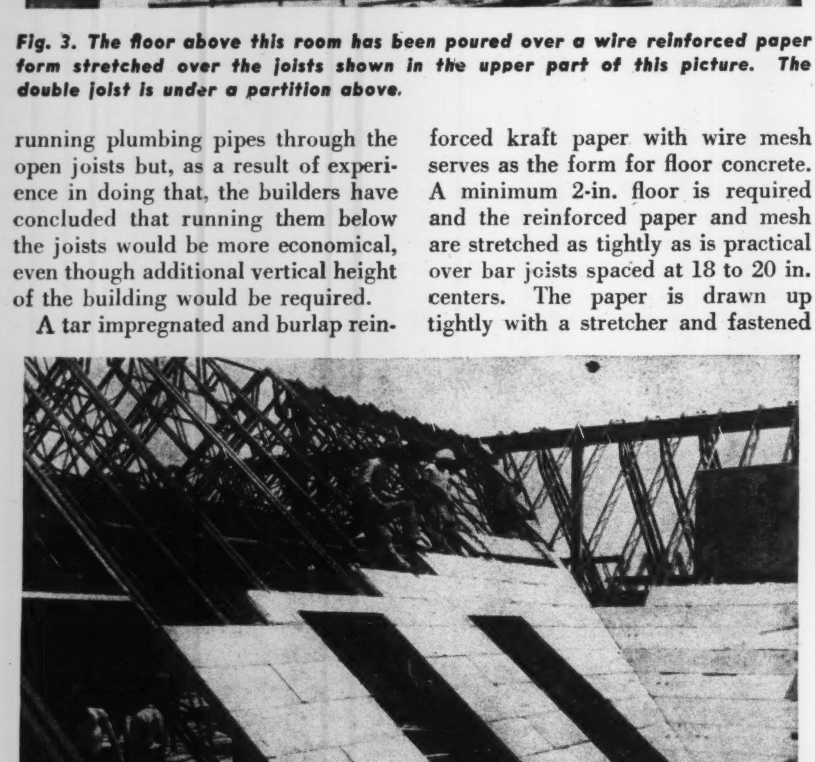

Fig. 4. Concrete "nailing" plank over open-web joists span 4 ft. above dormer windows and 2 ft. elsewhere to carry a slate roof.

Missouri Analyzes Typical Highway Job to Determine Actual Construction Costs

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***Contents in Brief**—Carefully compiled daily records enable the Missouri State Highway Department to determine accurately the contractor's actual construction costs on all contract items of a typical highway project. Chief items include: labor, materials, equipment charges and overhead.*

WHAT does it actually cost a contractor on a typical highway construction project to move a cubic yard of excavation or to place a cubic yard of concrete? How should his overhead expenses and equipment charges be prorated, together with the costs of labor and materials, to determine the total cost of clearing an acre of right-of-way, compacting a cubic yard of embankment, laying a square yard of concrete pavement, or completing any one of a hundred other items to be found in the typical highway and bridge construction project?

To secure these answers and, in order that comparative cost data of various jobs will be available when it is necessary to analyze future bids or determine agreed contract prices, the Missouri State Highway Department is completing a detailed cost analysis of one of its current highway projects.

The first step was to place the investigational work directly in charge of a competent employee of the department with instructions to make a complete study of the situation. His first move was to discuss what information was desired with a number of reputable contractors in this area so that he would be in possession of the various methods used by them in arriving at unit costs. Neighboring states were contacted to secure what information they had on the subject. Available literature and text books also were studied and all information in general was assembled.

It was hoped that the investigational work would produce a definite outline on how to proceed, but such was not the case. Contractors' cost data revealed good information on profit or loss on entire projects but lacked detailed information on individual items. Most of the contractors had at one time endeavored to keep cost information on each contract item, but they had abandoned the idea because it required such a great amount of work to keep the cost information in a manner that permitted operating costs of one project to be compared with other projects.

Neighboring states had some information of value and the literature helped, but in general, the combined information from all sources was inadequate.

Large project chosen for study

It was decided to select a representative project that contained most of the items usually encountered in highway construction and attempt to develop a cost system that would satisfy the department's needs. A large project on U. S. Highway 24, in Chariton County, seemed to satisfy this requirement and therefore was used; but, since the project is not complete, cost figures as shown do not represent total actual cost to the contractor.

This project is 4.9 miles long and involves heavy grading, culverts, subbase construction, 8-in. portland-ce-

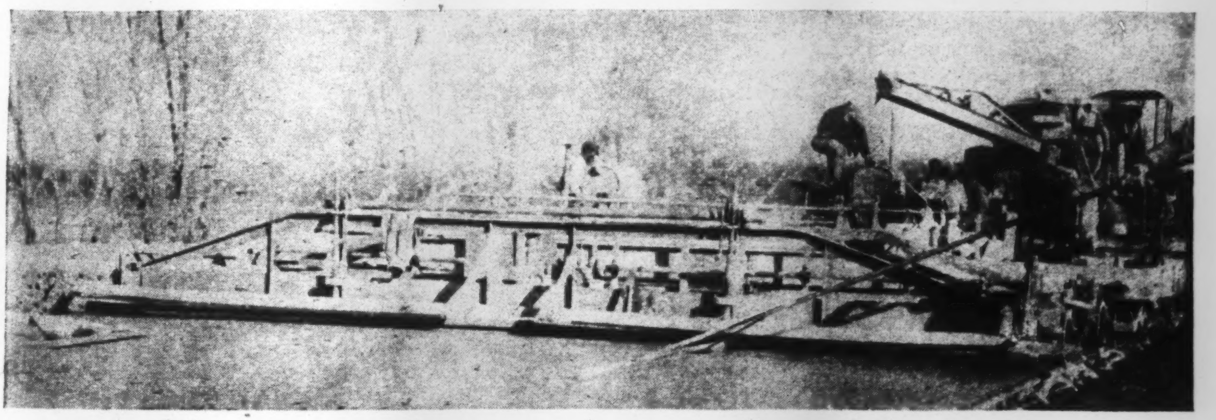


Fig. 1. Materials, labor, equipment charges and overhead—all are included in job costs on a Missouri highway project.

Fig. 2. Equipment ownership rates are based on recommended AGC rates, modified to meet existing conditions.

ment concrete paving, two bridges, and other incidental items. One bridge will have thirteen 20-ft. and four 20-ft. 3-in. concrete spans. The other will contain two 50-ft. and one 55-ft. deck girder spans.

The original grading quantities include 262,250 cu. yd. of Class A excavation, 1,900 cu. yd. of Class 3 excavation, 212,600 cu. yd. of compacting embankment and 608,570 cu. yd. stations of overhaul. Other original plan quantities that will aid in visualizing the size of the project were 61,720 sq. yd. of portland-cement concrete pavement, 320 cu. yd. of box culvert concrete, 37,480 lb. of reinforcing steel, 440 lin. ft. of 18-in. reinforced concrete pipe, 100 lin. ft. of 30-in. reinforced concrete pipe and 430 sq. yd. of light stone revetment.

Cost keeping

The contract for this project, like all others involving federal funds, requires the contractor to supply weekly certified payrolls on which supervisory, skilled, intermediate and unskilled labor must be separated. This information is required to be shown for each man employed on the project. (Table I). Subtotals and "totals to date" also must be shown for each labor group. Payroll deductions have been omitted for the sake of simplicity.

It was decided to use this standard payroll form as a nucleus since all concerned are familiar with its preparation, and then devise some method of determining the item or unit to which each man's time should be charged. Contractors are not required to show equipment hours on payrolls but it was comparatively simple for the project engineer to compute the operating time of each piece of equipment from the time shown for the operators.

Several methods were tried to determine an accurate, inexpensive system of prorating each man's time and the time of each piece of equipment to the various units or items involved in the contract, and the following was adopted. A number was assigned each contract item in order to expedite both the field work and the preparation of the various reports.

On the trial project, for example, key numbers from 1 to 100 were used. These same numbers will be used on all future cost information data so that direct comparison of results may be made. Space does not permit recording the entire list, but the following numbered items are given since they are mentioned in this description of the cost-keeping method:

Item No.	*Contract Item*
1	Clearing
3	Hedge Removal
4	Class A Excavation
5	Class C Excavation
6	Sandstone Excavation
9	Overhaul
10	Compaction of Embankment
20	Class 3 Excavation (Culverts)
21	Class B Concrete (Culverts)
23	Reinforcing Steel
27	30-in. Reinforced-Concrete Pipe
43	Portland-Cement Concrete Pavement
82	Grouted Light Stone Revetment
84	Grouted Heavy Stone Revetment
100	Labor not chargeable to the job

The project or resident engineer on the job compiles a list of all men and all pieces of equipment assigned to the project, in a field notebook. Each day he, or his representative, checks with the contractor's foremen and the state's inspectors and inserts proper notations after each man's name and each piece of equipment to indicate the number of hours that should be charged to the various units in the

TABLE I—WEEKLY CERTIFIED PAY ROLL FORM FOR ALL FEDERAL AID PROJECTS

Name and address of employee	Labor position	Hours worked daily. Sept.: 1, 2, 3,4, 5, 6, 7	Total for week	Rate per hour	Total earned	Deductions	Actual wages paid	Remarks
Supervisory:								
D. L. Jones, Kansas City	Foreman	8 8 8 8 8 8 0	48	$2.00	$96.00	0	$96.00	
Skilled:								
R. P. Burns, St. Louis, Mo.	Cat. operator	6 8 6 8 0 8 0	36	1.75	63.00	0	63.00	
Intermediate: (none)								
Unskilled:								
C. A. Smith, Jefferson City, Mo.	Laborer	10 8 6 0 0 0 0	24	1.00	24.00	0	24.00	
K. L. Parr, Columbia, Mo.	Laborer	10 5 5 0 0 0 0	20	.90	18.00	0	24.00	

TABLE II—FIELD NOTES ON LABOR CHARGED TO CONTRACT ITEMS

(For Sept. 1, 1946)

Name	Classification	Number of hours	Charge to item No.
Supervisory:			
Jones, D. L.	Foreman	8	4
Skilled:			
Burns, R. P	Caterpillar operator	0	..
Intermediate:		0	0
Unskilled:			
Smith. C. A	Laborer	5–5	10–84
Parr, K. L	Laborer	4–6	1–3

contract. Tables II and III are typical examples of these field notes

The project engineer will know from the figures in Table II that on September 1, 1946, Smith worked 5 hours on item No. 10 which is "Compaction of Embankment" and 5 hours on No. 84 which is "Grouted heavy stone revetment." On the same date Parr worked 4 hours on No. 1 which is "Clearing" and 6 hours on Nov. 3 which is "Hedge removal." He also will know, from Table III, that Motor Patrol #1 worked 5 hours each on items 4 and 10; Motor Patrol #2 worked 10 hours on No. 4; the 3-sack mixer worked 5 hours each on Nos. 21 and 82; and one shovel and two trucks each worked 8 hours on No. 5.

The "Remarks" following each piece of equipment supply helpful information for determining the proper equipment ownership rental costs. By referring to the key numbers, it is apparent that No. 4 is "Class A Excavation," No. 10 is "Compaction of Embankment," No. 21 is "Class B concrete (Culverts)", No. 82 is "Grouted Light Stone Revetment," and No. 5 is "Class C Excavation."

From this information the engineer in the field can determine the number of hours each man and each piece of equipment is employed on each contract item daily and by adding the daily hours he can determine the number of hours that should be prorated to the various items each week. The weekly certified payroll (Table I) shows the total hours worked each week and with the information on what units each employee worked, it is a simple matter to determine the percent of total time that should be charged to each unit in the contract. This is accomplished by making use of the "Remarks" column on the certified payroll.

Continuing with the example previously referred to, in the remarks column after Smith's name would appear (50%-#10) (50%-#84) and after Parr's name (40%-#1) (60%-#3.) This, of course, assumes Smith and Parr continued to work the same time on the same items throughout the week as indicated for them on Sept. 1, 1946. Similar notations would appear after the list of each piece of equipment.

Data assembled on weekly basis

The field engineer submits this information weekly to the highway department's main office, where it is assembled under each contract unit.

TABLE III—FIELD NOTES ON EQUIPMENT CHARGED TO CONTRACT ITEMS

(For Sept. 1, 1946)

Kind and size	Type	Number of hours	Charge to item No.	Remarks
Motor patrol #1...........	Grading.......	5–5	4–10	Operating ½ time
Motor patrol #2...........	Grading.......	10–0	4–0	Operating ½ time
Mixer (3-sack)............	Culverts.......	5–5	21–82	Not operating continuously
Shovel (1½ cu. yd.).......	Grading.......	8	5	Operating all day
Truck #1..................	Grading.......	8	5	Operating all day
Truck #2..................	Grading.......	8	5	Operating all day

Note: All equipment assigned to project is included in this table.

TABLE IV—WEEKLY LABOR DISTRIBUTION FOR EACH CONTRACT ITEM

		Totals this week									
		Hours		Wages							
Payroll date	Labor (position)	Overtime	Regular	Overtime	Regular	Total to date Hours	Total to date Wages	Item #1 Hours	Item #1 Wages	Item #100 Hours	Item #100 Wages
9-7-46:	Supervisory	...	...	...	...	...	...	...	...	...	...
	Skilled	...	...	...	...	...	...	...	...	...	...
	Intermediate	...	...	...	...	...	...	...	...	...	...
	Unskilled	...	...	...	...	...	...	...	...	...	...
9-14-46:											

TABLE V—RATIO OF OVERTIME PAYMENTS FOR LABOR

(For all grading quantities)

	Hours			Amounts paid		
Classification of labor	Overtime	Job total	Percentage of overtime	Overtime	Job total	Percentage of overtime
Skilled...............	4,906	18,173	37.2	$9,715	$28,115	34.6
Intermediate..........	1,467	6,205	23.6	2,211	7,187	30.6
Unskilled.............	3,009	17,103	17.6	3,460	13,703	25.2
Total.................	9,382	41,481	22.6	$15,387	$49,005	31.4

The percentages are converted into hours and wages, and "weekly subtotals" as well as "totals to date" are maintained. Overtime payments are separated from regular time payments as considerable overtime, which is one and one-half and double times regular wages, may account for a very high unit cost. This information is assembled in the main office on a form similar to that shown in Table IV, in which all the items numbered 1 to 100 are listed, corresponding with the master key listing.

If we desired only the labor costs per unit of contract, the job could be brought to completion by dividing the various quantities actually constructed into the total cost of labor for each unit. However, since the total final cost of each item is the goal, it is necessary to determine the overhead costs, the equipment ownership costs, the cost of parts and other articles utilized in construction together with the materials costs, and add them to the labor costs.

Overhead costs necessarily must include such items as office rent, telephone calls, timekeeper wages, expenses incurred in bidding and other expenses incurred in the normal operations of a contracting firm. To these must be added the expense of moving equipment onto the job, insurance of all kinds, and cost of bond. The engineer depends entirely on the contractor for all overhead costs.

Equipment ownership costs

It already has been described how the hours of equipment operation are determined for each unit in the contract. If a definite figure could be supplied as an equipment ownership rate that would fit all cases, the job would be very elementary. It would involve only the mechanical operation of multiplying the rate times the hours to get the equipment cost per unit of contract.

Consideration was given to using the OPA rates, the Associated General Contractors' rates, our state highway department's rates, those used in other states, and the actual depreciation rates used by some contractors.

A list of all the equipment was compiled and opposite each piece of equipment the following information was inserted: cost, age, standard AGC rate, revised AGC rate, the rate based on percentage of capital investment, Missouri State Highway Department rate, other state highway department rates, OPA rate, actual rent or royalty paid by contractor, dates during which the equipment was on job, and the number of days it was actually working. Revised AGC rates are based on the equipment working fewer hours per month than is the case with the standard AGC rates.

By way of explanation, the standard AGC rate per hour is obtained by dividing the monthly AGC rate by 240, which is the product of 30 days multiplied by 8 hours. The revised rate assumes only 20 working days of 8 hours each. Consequently, the revised AGC rate is obtained by dividing the same monthly rate by 160 to get the hourly rate. The above mentioned rate based on percentage of investment also is different from the other rates as it provides for a certain percentage of original cost of the equipment per day without considering the AGC rates.

It was immediately apparent that it would require a combination of the various rates because the OPA rates were too high in comparison to all the others, the AGC rates did not make sufficient distinction between active and idle rental and the state highway departments' rates were based chiefly on maintenance work, which does not depreciate equipment as rapidly as construction operations. The AGC rates, however, supplied an excellent guide after consideration was given to the increased price of the equipment, the actual operating time, and local job conditions.

Repair parts and materials

"Hours of equipment operation" were converted into "days" in order to simplify the work, and proper consideration was given to the actual working conditions in arriving at the "equipment ownership rates" to be used.

It is recognized that the rates used are not necessarily the correct or actual cost to the contractor, but since it is impossible to determine the actual rates until the equipment in question has served its time and been disposed of, we feel they are as close as can be estimated and the method will serve to compare costs on similar projects.

Costs of all repair parts for equipment used on the job, exclusive of labor, had to be obtained from the contractor. Such items as form lumber, form ties, nails, dynamite, etc., are classified as other articles used in construction. Since repair parts are a part of equipment ownership rates, they will not appear as a separate item in computing unit costs.

Actual material costs are determined by keeping an account of the actual amount of materials used in the construction of each contract item and multiplying the various amounts by the unit price paid by the contractor for the material involved. This system makes allowance for wasted material as the total amount purchased by the contractor must be accounted for.

It is necessary to prorate certain costs such as insurance, bond and general overhead expenses. This is done on a money basis by determining what percent the money value of a certain item is to the contract total. All charges are confined to the larger items in the contract and the proration is based on the money value of the original contract quantities since they were the only figures avail-

TABLE VI—ASSEMBLED CONSTRUCTION COST INFORMATION ON MAJOR CONTRACT ITEMS (May 1 to Oct. 24, 1946)

Item No.	1	4	6	9	10	20	21	23	27	43
Contract item	Clearing	Class A Excavation	Sandstone Excavation	Overhaul	Compaction Embankment	Class 3 Excavation (Culverts)	Class B Concrete (Culverts)	Reinforcing Steel	30" R.C. Pipe	P.C.C. Pavement
Unit	(acres)	(cu. yd.)	(cu. yd.)	(cu. yd. sta.)	(cu. yd.)	(cu. yd.)	(cu. yd.)	(lb.)	(lin. ft.)	(sq. yd.)
Quantities involved	11.9	223,500	11,500	540,000	195,000	1,850	316.8	37,480	104	42,432
LABOR COSTS:										
Supervisory	$6.5454	$0.0089	$0.0050	$0.0012	....	$0.0908	$0.3919	$0.0020	....	$0.0590
Skilled	10.6874	0.0390	0.0670	0.0033	$0.0120	0.0677	3.0127	0.0085	....	0.0560
Intermediate	2.0504	0.0058	0.0139	0.0004	....	0.0580	1.3313	0.0043	....	0.1066
Unskilled	28.2151	0.0011	....	0.0001	....	0.5037	4.7213	0.0258	$1.6049	0.1676
Total labor costs	47.4983	0.0548	0.0859	0.0050	0.0120	0.7202	9.4572	0.0406	1.6049	0.3892
EQUIPMENT:										
Ownership & rental	8.3294	0.1329	0.2134	0.0056	0.0241	0.0083	1.4105	0.0010	0.1258	0.4294
Fuel & lubricants	1.8672	0.0304	0.0482	0.0013	0.0055	0.0032	0.5408	0.0004	0.0483	0.0509
Moving & setting up	0.8773	0.0056	0.0220	0.0004	0.0005	0.0052	0.9014	0.0007	0.0803	0.0782
Total equipment costs	11.0739	0.1689	0.2836	0.0073	0.0301	0.0167	2.8527	0.0021	0.2544	0.5585
OTHER ARTICLES: (form lumber)	0.0	0.0	0.0	0.0	0.0	0.0	4.3851	0.0	0.0	0.0
MATERIAL COSTS:	....	....	....	....	....	....	....	....	3.4000	....
Reinforcing steel	....	....	....	....	....	....	....	0.0442	....	0.3299
Cement	....	....	....	....	....	....	3.6680	....	....	0.6566
Coarse aggregate	....	....	....	....	....	....	2.6203	....	....	0.6084
Fine aggregate	....	....	....	....	....	....	0.9236	....	....	0.2235
Curing	....	....	....	....	....	....	....	....	....	0.0395
Total material costs	0.0	0.0	0.0	0.0	0.0	0.0	7.2119	0.0442	3.400	1.8579
OVERHEAD:										
Job overhead	1.5126	0.0096	0.0374	0.0006	0.0009	0.0676	1.0480	0.0019	0.1634	0.0897
General overhead	2.6151	0.0173	0.0676	0.0010	0.0016	0.1415	2.2000	0.0041	0.3398	0.0252
Supt. allowances	1.2605	0.0072	0.0287	0.0004	0.0006	0.0486	0.7576	0.0016	0.2885	0.0658
Total overhead	5.3882	0.0341	0.1337	0.0021	0.0031	0.2577	4.0056	0.0076	0.7917	0.1807
GRAND TOTAL COST (per unit)	$63.9604	$0.2579	$0.5032	$0.0144	$0.0452	$0.9946	$27.9125	$0.0945	$6.0510	$2.9863

able at the time the contractor placed his bid or estimated his cost.

After each item of cost has been distributed to the various items in the contract, the unit costs are computed in such a way that they can be applied to other projects, even though the labor rate might be higher, the material more expensive, the haul longer or the job more difficult. For example, we will know the actual cost of labor per cubic yard and the estimated cost of equipment per cubic yard for Class A excavation, which includes all roadway and borrow excavation exclusive of ledge rock.

If the labor costs are higher on some similar job, it should be evidence that either the labor scale is higher, the material encountered more difficult or the efficiency less. Higher equipment costs probably would mean either more difficult material, inadequate equipment, improper direction or inefficient operation. It is comparatively easy to justify the unit costs where the wage scale is different, where the material encountered varies or where more intricate equipment is required, but an average condition has to be assumed for efficiency and management.

Overtime is a large factor

The item of overtime payments has become such an important item in the contractor's costs that it is worthy of considerable discussion. Contractors are required to pay one and one-half times the normal rate under certain conditions and twice the normal rate under others.

Since the form of payroll used in Missouri requires the contractor to show the total hours worked each week and the rate paid per hour, the hours and amounts paid in the form of overtime can be readily computed. Table V shows the hours and amounts of overtime actually paid compared to the total hours and the total amount paid on all grading items.

It can be seen from Table V that overtime hours for skilled labor amounted to 37 percent of the total skilled labor hours and increased the skilled labor payroll by an amount equal to 34.6 percent of the total.

The intermediate labor hours contained 23.6 percent overtime hours, which increased the cost 30.6 percent. Unskilled labor overtime amounted to 17.6 percent of total hours worked in that classification and increased the payroll unskilled labor cost by 25.2 percent.

Fig. 3. Job costs are reduced by using efficient materials-handling equipment and a spacious field garage, shown at the right.

Other items of interest revealed by a study of Table V are: skilled labor received $1.98 per hour for overtime and $1.38 for normal time; intermediate labor receied $1.51 per hour for overtime and $1.05 for normal time while unskilled labor was paid $1.15 for overtime and $0.73 per hour for normal time. The average wages paid all labor on grading operations for overtime was $1.64 per hour as compared to the normal rate of $1.18 per hour.

It is apparent from a study of overtime payments that payrolls may be expected to materially increase even in counties several miles from the metropolitan areas. It also is apparent that there now are many more positions being filled by skilled labor than by unskilled labor, as the hours of skilled labor on grading are 1.6 times greater than those of unskilled labor. Moreover, the pay received by skilled labor is 2.8 times greater than that received by unskilled labor.

Final operation in assembling the data on actual construction costs is the preparation of a table of cost information (Table VI). Quantities shown therein do not agree in amount with the original contract quantities since they represent only the amounts actually constructed up to Oct. 24, 1946.

Labor is separated into units costs for supervisory, skilled, intermediate and unskilled so that a study may be made of labor trends and the effect new equipment has on labor classifications.

Costs were computed for each item in the contract but only the more important items have been shown in Table VI, for the sake of brevity. Bridge items were not included as considerable work remains to be done on the bridges, which would tend to make the cost to date unbalanced. The final unit cost or costs after the project is completed may be expected to be higher for both grading and paving as the more expensive parts such as finishing operations remain to be constructed.

All costs listed in the table are actual except the equipment ownership costs, which were of necessity computed. All costs shown in Table VI are those incurred from the start of the job on May 1, to Oct. 24, 1946.

It is also worthy of note that the cost analysis of this particular project indicates low labor costs for both grading and paving which is accounted for by the fact that the overhead costs are listed separately and the project on which the costs were compiled is located in a low wage area. A more representative cost could be realized by adding the job overhead and superintendent allowance costs to the labor costs.

Enngineers on the job

The men responsible for developing the above method of cost analysis and for compiling the cost information on the construction project located on U. S. Highway 24 in Chariton County are: J. J. Corbett, engineer of construction for the Missouri State Highway Department; the writer; A. R. Towse, general inspector; R. C. Kealey, project engineer; and the contractors superintendents.

Stripped by War and the Soviets Manchuria Faces Huge Rebuilding Job

Martin Toscan Bennett
Consulting Engineer, Washington, D. C.
Chief of Staff, Pauley Mission

***Contents in Brief**—More than a $800 million loss has occurred to the basic industries of Manchuria during the time of the Soviet occupation of the country. Machinery removals bulk large in this total, so that electric power capacity is reduced by 71 percent, metal working by 80 percent, cement production by 50 percent and so on. Railroad rolling stock and track have disappeared, and all bridges are wrecked. The part of Korea occupied by the Soviets has not suffered comparable damage, but kept separate from the American occupation zone it has throttled the development of the country as a whole. A huge reconstruction task faces this Northwest Asia area in which American capital and technical skill must play prominent roles.*

THIS IS A STORY to make an engineer's heart bleed. It's not told for that purpose, but to show how much of what was good is destroyed and what a tremendous lot of engineering there is to be done in this world before it can get back to what it was—to say nothing of making it what we want it to be.

I have recently completed a trip around the world and have been in many places where no Americans have been for years. Two of these places, Manchuria and north Korea, had a story to tell that none but a few newspaper reporters and intelligence observers had many ideas about, and most of these ideas had been wrong. The error came from their lack of a technical background, necessary for accurate observation of industries and public works.

When, therefore, Edwin W. Pauley, Ambassador of the United States and Special Representative of the President on Reparations, received his instructions from the President to inspect the formerly Japanese-owned assets in Korea and Manchuria, he realized that an adequate and competent job could be done only with the help of engineers. I was chosen chief of staff, and in spite of our organizing the mission in only a couple of weeks, we secured excellently qualified representatives of all branches of engineering. In addition, in Tokyo, where we stopped to secure as much information as possible from Japanese records of investments in Korea and Manchuria, we were joined by a number of engineers from the Army who accompanied us to the continent. We were, therefore, well equipped to evaluate the observed war damage and "war booty" removal of equipment, which was the principal objective of the mission.

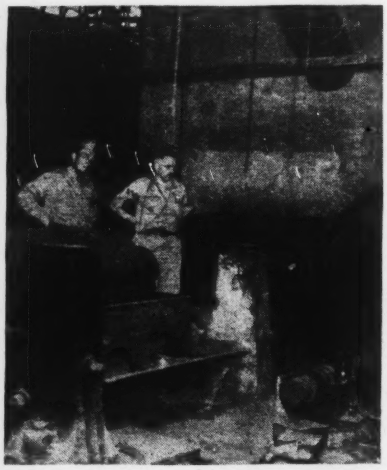


Fig. 1. Ambassador Edwin W. Pauley and the author view the only piece of equipment remaining in the plant of the Mukden-Toyo Tire Co., a partly dismantled roll.

Our route took us first to Seoul, the capital of Korea, a modern city with a number of public buildings and well paved streets. Seoul was the logical headquarters for our travels in Korea, and a point of departure for Mukden, Manchuria, from whence the investigation of conditions in that country were conducted, which is the principal subject of this article.

Korea, it may be noted in passing, is a land-poor country—rich in natural resources, rich in industrial capacity—but lacking in certain kinds of factories and in working capital. From the air it looks much like Japan with many steep mountains and with every square inch of tillable land being worked. One realizes when flying over much of the Far East what a large part of the total wealth is in the form of land improvements, drainage, irrigation, terraces, paddies, etc. The roads, like those in the rest of Asia, are terrible; few of them surfaced and most are on the narrow tops of dikes running through the paddy-filled valleys.

Korea suffered only slight war damage, and from what we saw and were able to determine, has lost little, if any, of its industrial equipment to the Russians. Its difficulties rise from two causes—long years of Japanese domination and the present division of the country into two economies—one under Soviet domination, north of the 38 degree parallel, the other guided by the American forces under General Hodge. While the Japanese built up a sizable industrial capacity in Korea, they retained in Japan the facilities necessary to complete the conversion of products of natural resources into consumer or capital goods. The significance of the Soviet-

American division of the country is evident from the following figures:

	Percent North	Percent South
Population	33	67
Food Production	35	65
Coal	80	20
Iron and Steel	95	5
Hydroelectric Power	90	10
Chemicals	85	15
Machinery	35	65
Consumer Goods	20	80

Hydroelectric power is the one commodity that appears to be passing freely from north to south Korea. But nearly every plant we visited in south Korea was having difficulties because of its dependency on raw materials from north of 38 degrees.

The railroads of north Korea appear to be improving under Soviet control. Likewise the industries are operating at increasing capacity, and there was little evidence of equipment removals by the Russians. The three ports that we visited appeared not to have suffered, but we did not see the two principal ports of the northeast—Ch'ongjin and Hungnam. In the areas which we could see, all port facilities seemed to be as the Japanese had left them. We did not visit any of the hydro plants but we were close enough to a number of high-voltage substations to hear the hum of the transformers and to know that the system was thoroughly energized. By and large, the picture in north Korea was far different from what we had anticipated from the many reports that had filtered into the American Zone.

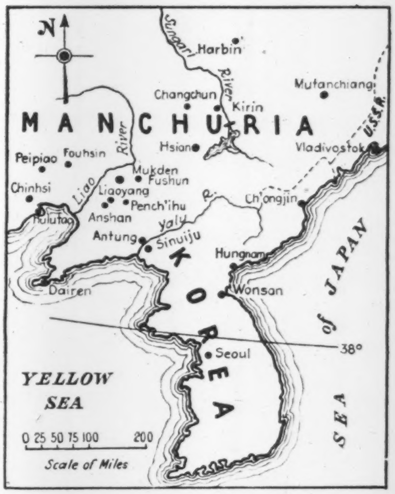


Fig. 2. Area of Manchuria and Korea covered by the Pauley Mission.

The trip from Seoul, Korea, to Mukden, Manchuria, was by plane, which had to take us far west beyond the Kwantung peninsula in order to avoid flying over the forbidden Soviet naval base which includes the alleged free port of Darien. As we flew northeast across Manchuria, we could see from our 8,000-ft. altitude many signs of the war which was going on below us. Along the railroad line that we followed every bridge, large and small, had at least one span knocked down. On the wide Mukden plain industrial housing was reduced to brick walls and bare chimneys, not the result of shell fire but the results of the Chinese natives' frantic search for fuel which caused them to lift out every piece of combustible material in any unoccupied building.

Manchuria has been the "cradle of conflict," as it was called by Owen Lattimore, for many generations. At one time, it was the home of the Northerners who invaded China so frequently that the great Chinese walls were built as defenses against them. During the 20th Century, however, it has been the center of much rivalry for its control. The clash of Russian and Japanese interests in Manchuria was the principle cause of the Russo-Japanese war in 1904. Control of the railroads was a contest until the Japanese seized Manchuria in 1931 and subsequently drove all competing interests out.

Like adjoining Korea, Manchuria abounds in many natural resources, the most valuable of which is a plentiful supply of coal. It is also one of the few areas in the Far East that has consistently produced an agricultural surplus. It is well forested in the North and has large hydroelectric potentialities.

Estimates of what the Japanese put into the industrial development of the country run in the neighborhood of three billion dollars. The economy, by and large, was developed to supply Japan with natural resources, and the primary products thereof, which are not available in the home islands. Our assignment was to evaluate the amount and condition of these Japanese developments, and we found that such destruction had taken place as

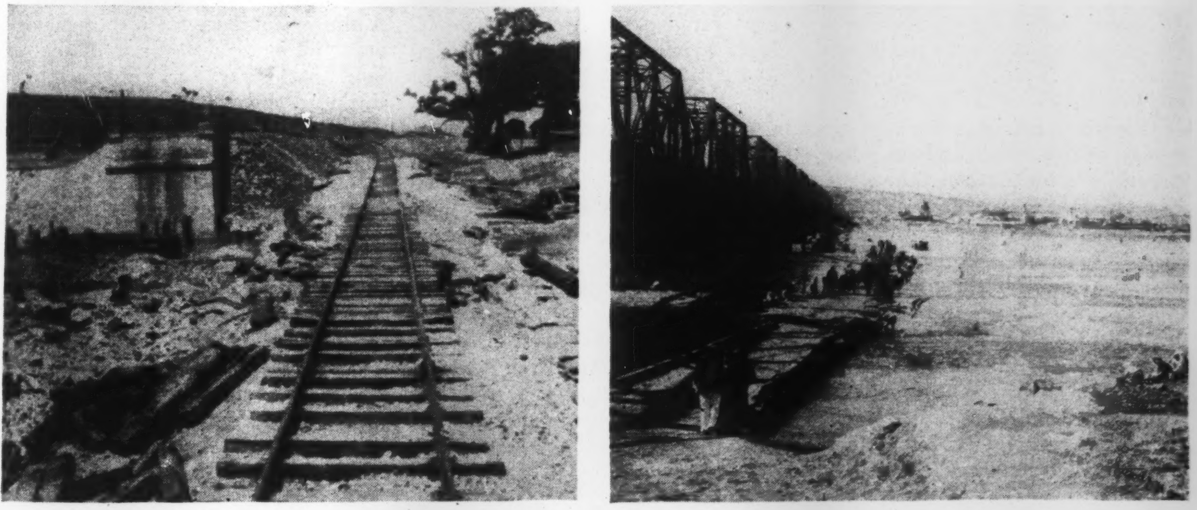


Fig. 3. Wrecked bridges are bypassed by laying track across a dry river (left) or by building planked roads of logs and pipe across shallow streams (right) in the war-torn regions of Manchuria.

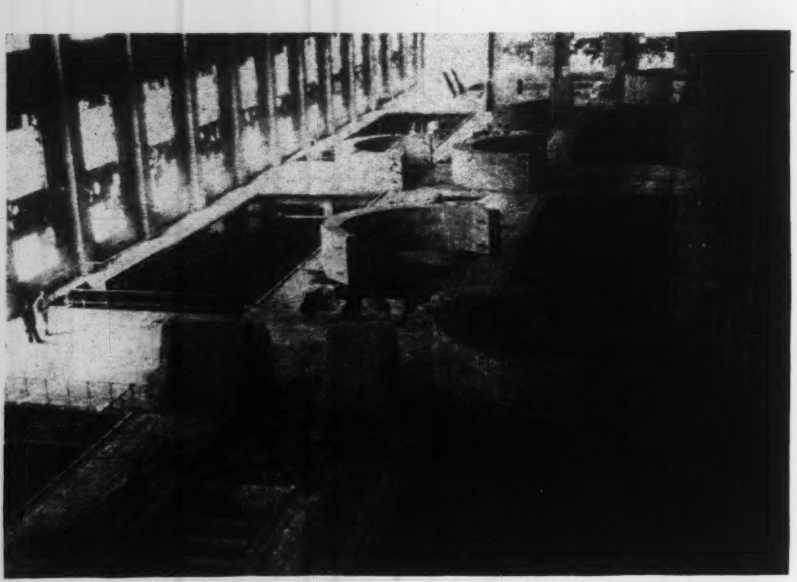


Fig. 4. Holes were all the Soviets left when they removed the three 50,000 kw. turbo-generators from the Fushun power plant. Curved pieces are portable concrete revetments used by Japs to protect machines from bomb fragments.

to require us to make a much more extensive survey than we had originally contemplated.

Unsanitary and crippled Mukden

Mukden is a large city built up around a much older Chinese or Manchurian city. The old quarter, like the old quarter of many Chinese cities, still had many of the old defensive walls standing. The streets surged with people and vehicles, man and animal drawn. Our nostrils, long since become accustomed to lack of drainage and sanitation, were probably not conscious of all that was assailing them. But in the sunny spots one could see thousands of flies streaking back and forth, and even though every draft animal dangled a manure catcher beneath his tail, the streets were well coated with an accumulation that wind and man had not bothered to collect or move.

The city had electric power at only very seldom intervals, and public transportation was provided by pedicabs and homemade carts which ran on every kind of wheel imaginable from big, heavy, brass-studded Chinese discs to small, balloon-tired airplane wheels. Every time we passed a well pump, a cluster of people would be around it collecting water in various kinds of vessels from tin cans to porcelain vases. The city has been without water supply since the Soviets had removed the nearby power plant.

The reports which we had had that Manchuria was "stripped" were exaggerated, but the results of what had happened are as bad. We found the big copper smelter in Mukden practically intact except that all stocks of finished metals had been removed. The old Mukden arsenal had lost a third of its 10,000 machines, of course, including the newer ones. The Chinese Nationalists were cannibalizing the remainder and were actually producing small arms amunition. The new arsenal, however, was a shambles. The equipment was almost completely gone, parts of the buildings had been burned, and unexploded grenades and shells were lying all about. This plant had employed 10,000 people at peak.

In the large Mitsubishi Engineering Works, nearly everything movable had been taken. This plant manufactured a wide variety of machined products as well as light military tanks, mining machinery, heavy springs, etc. In most plants we visited, the motor and hoist mechanisms had been removed from the overhead track cranes. In this plant the entire cranes were gone and even some of the track. The equipment removed also included electric furnaces and some large hydraulic presses. Many of the other industries in Mukden told a similar story.

Since Mukden was a noted arsenal city, we were unprepared to accept its condition as being typical of Manchurian industrial centers. Later we found that its condition was typical of all Manchurian cities, including those controlled by Communists. Before our mission ended, we had visited all but two of the more important industrial cities in Manchuria. We were never successful in securing Soviet permission to visit Dairen. Chinese Communist officials claimed to be unable to land us in Antung just across the Yalu River from Sinuiju, the northernmost point we had reached in Korea.

Itinerary of the mission

We used Mukden as a base, traveling by rail and occasionally by plane to the other industrial areas, Fig. 2. We went east to Fushun by train, south to Pench'ihu, Liaoyang and Anshan, also by train. Some of our party went west to Foushin and as far south as Chinhsi and the area in west of the port of Hulutao. We stopped at many way stations and made further reconnaissance by plane. The rail line north was cut off by fighting but by flying to the capital city, Changch'un we were able to cover a radius of 50 to 100 miles by rail, including Kirin and the nearby hydro project at Tafengmen. We flew also to Harbin which was then deep in Communist territory. From there we went by rail 200 miles east to Mutanchiang, 75 miles from the Soviet border.

The special trains put up for us by the cooperative and efficient North Eastern Economic Commission of the Chinese Government were composed of relics of regal days for dining car and "parlor car" service. Each train included a car or two of soldiers and two flat cars loaded with jeeps. Why the jeeps stayed on the cars we never knew because part of the time they were merely blocked with stones or lashed with straw rope. Actually we carried them hundreds of miles, driving them off and on at each stop on a tail gate laid against the car, without a single mishap.

While the Chinese Nationalists have recovered much of the more important track mileage in Manchuria, it is operated only with great difficulty and under constant harassment by Communist forces. Guards in pillboxes are placed at least every mile of track and at every bridge or switch.

The trains move slowly and only during daylight.

We were told that the Nationalists had taken over less than 10 percent of the 2,000 locomotives and 3,000 passenger cars, presumably left behind by the Japanese, and that less than half of these were operable. The Nationalists were able to account for only 3 percent of the 30,000 freight cars the Japanese should have left behind.

We were further informed that the Soviets had taken up the rail from over 800 kilometers of track. Since the missing freight cars would fill two or three hundred miles of track and since the Soviet tracks are 5-ft. gage instead of 4-ft. 8½ in. gage of Manchuria, it seems rational to assume that the missing rail was laid as connecting tracks into Siberia, where the missing freight cars may now be standing loaded with equipment removed from Manchuria. This is only surmise but it seems to be the best explanation of what could have happened to so much rolling stock that could not operate on Soviet tracks without substantial alteration.

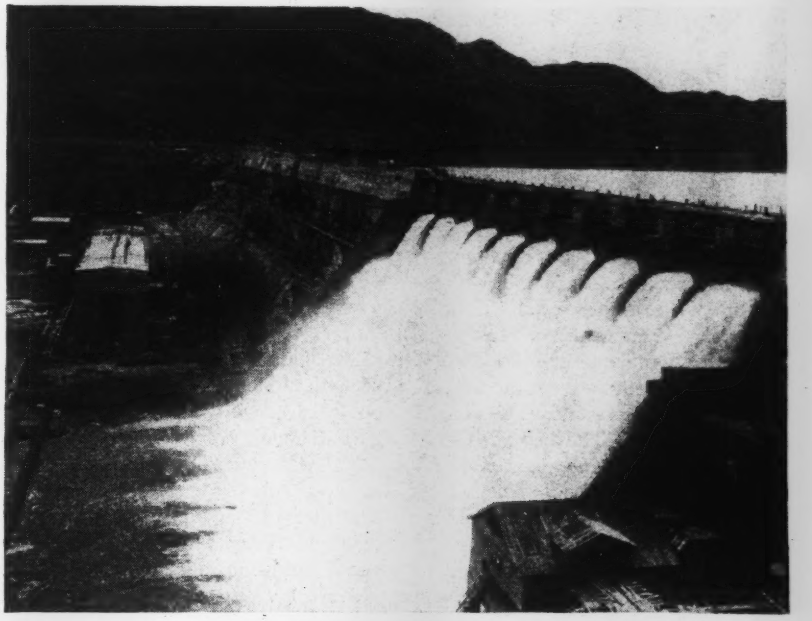


Fig. 5. Tafengmen Dam, whose power installation was designed for 563,000 kw. Soviets removed all but two 70,000 kw. generators as well as the equipment from the concreting plant at the right required for completing the dam.

Fig. 6. One of the world's largest open-cut coal mines, at Fushun, which is 400 ft. deep and 12 miles long. Soviets removed so much of the mining equipment that only about one-third of normal production can be attained. In background is a shale-oil plant whose raw material was the mine overburden.

Most bridges wrecked

As we rode along the rails we saw other signs of conflict. An undamaged bridge was a great rarity. Apparently the sapper's technique was to blow a span off an abutment or to blast out a pier. Most of the wrecking of bridges had been done in the civil war, but a number had been destroyed earlier by the retreating Japanese. The repairs were varied.

Near Fushun we passed a bridge over a river bed where a pier had been blasted out, dropping the ends of two adjacent spans. Unable to raise the spans, the Chinese had filled in the opening up to the original level with cribbing made of ties. A pair of light girders and new rail had completed the repairs. At other places the track was merely swung off the embankments down into the dry creek beds which it had crossed on only a few feet of fill.

At Pench'ihu a large bridge (Fig. 3, right) had lost two long, high spans. The Chinese had been unable to reconstruct anything that heavy, but they had recovered large piles of pipe of various sizes which they had laid on the rocky stream bed to let the water through and were building a roadway on top. The bridge would be bypassed. Practically all of the marshalling yards had been stripped of ties required for cribbing under damaged bridges.

At Fushun we saw the first and best example of Soviet removal of power generation equipment. The big Fushun power plant (Fig. 4) had been stripped of three 50,000-kw. and two 25,000 kw. Mitsubishi turbo generators. Apparently an excellent job of moving had been accomplished judging by the completeness. This plant was an interesting contrast to a similar plant at Fouhsin, where two 27,000-kw. and two 53,000 kw. turbo generators had been removed. Judging by the quantity of broken parts lying about, however, the removals had not been too successful. At Fouhsin they had also removed another pair of 53,000 kw. turbo generators which had not been installed.

At the Tafengmen hydro plant on the Sungari River south of Kirin (Fig. 5) we found only two 70,000-kw. generators remaining. This project had not been completed before the end of the war. Three installed units of the same size and two additional units in the process of installation had been removed along with a generator for an eighth unit. These units were a variety of designs including Westinghouse, Hitachi and Swiss and German makes. The Soviets had also taken five 70,000-kw. step-up transformers from the 220-kv. and the 154-kv. substations as well as plant auxiliaries. They also removed most of the concreting plant used for building the dam, 3,500 ft. long by 300 ft. high, which has not been entirely completed.

In all Manchuria we saw eight of the fourteen larger electric power plants, which aggregated about 60 percent of the total generating capacity, and we secured fairly well documented reports on the remainder. We found that about 1,400,000 kw. out of 2,150,000 kw. of installed capacity had been removed, including nearly 400,000 kw. of partially installed equipment. Of the remaining 750,000 kw., less than 450,000 kw. can actually function in serving loads because of poor condition and lack of transmission facilities.

At Fushun we saw the world's largest open-cut coal mine. The pit (Fig. 6) is about 400 ft. deep, and 12 miles long, and about a mile wide at the top. One side of the pit has been cut back to a series of benches on which power shovels load trains on the next bench below. Only the bottom two or three benches are actually coal; the remaining dozen benches are used for removing overburden and oil shale, the latter being switched by rail to a nearby plant where it is processed in a combination gas producer and internally heated still to recover the 4 to 15 percent oil content. The shale-oil plants operated in connection with the mine had a capacity of two million barrels of oil per year, but never succeeded in operating at more than 70 percent of rated capacity. So far as we could determine, the plants were in good condition, but were unable to operate because of lack of ability to mine the shale.

While the Soviets had removed power shovels, locomotives, mine cars and maintenance materials, even if they had not done so, the Fushun mine could operate only at a small portion of its capacity because of lack of power. The Fushun power plant, because of its stripped condition, could supply only a little more power than was necessary to keep the water pumped out of the larger pit.

At peak, the Fushun mine produced nearly 9 percent of Manchuria's total of 25 million tons per year. It will be the largest producer for some time and probably will account for more than a third of all the coal mined. At best, Manchuria's production will not exceed the rate of two and a half million tons per year until substantial rehabilitation is effected. The normal consumption for residential heating alone is four million tons, a fact that indicates the urgency of rehabilitation.

At Fushun we saw also the large plant originally designed for processing shale to produce alumina, but the large installation of electric furnaces had been manufacturing calcium carbide at the end of the war. A large part of the electric equipment had been removed by the Soviets. We saw a few large low-voltage single-phase transformers which had been abandoned in the process of removal with the Russian stencil still on them.

Wherever we went we found a similar story—extensive removals of equipment, great destruction, yet no consistent pattern of what was taken or what was left.

The Fouhsin coal mines and power plant were in worse condition than similar industries at Fushun. The Hsain coal mines were damaged but the removals did not bulk large. The Peipiao power plant and coal mines were in fair condition when we first examined them, but three days after we left the Communists re-took the city, destroyed a generator and a boiler and some of the mining equipment. The mines will flood until repairs are made.

Steel plants and factories stripped

At Anshan we saw the big steel works and a number of steel working industries that had grown up around it. Here, destruction allegedly by the Chinese Communist Army had been added to destruction by Soviet removals. Blast furnace auxiliaries, blooming, billet, bar and plate mills had been removed (Fig. 7) and coke ovens were rendered inoperative by removal of blowers, pumps, etc. A number of other plants had suffered, including the large pipe mill of the Sumitomo Metallurgical Co., which was completely stripped.

At Pench'ihu the coal mines and the large blast furnace plant did not suffer from large removals but hundreds of relatively small items such as motors, blowers, hoists, valves,

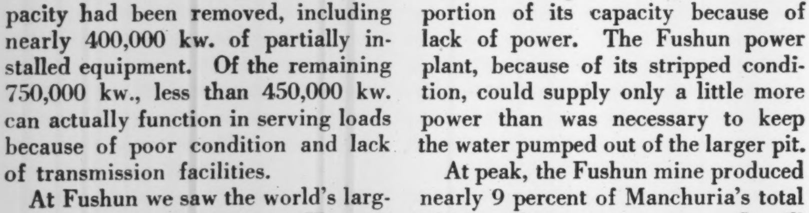


Fig. 7. The empty shell of the blooming mill of the Anshan Steel Works after the Soviets had removed the rolling equipment.

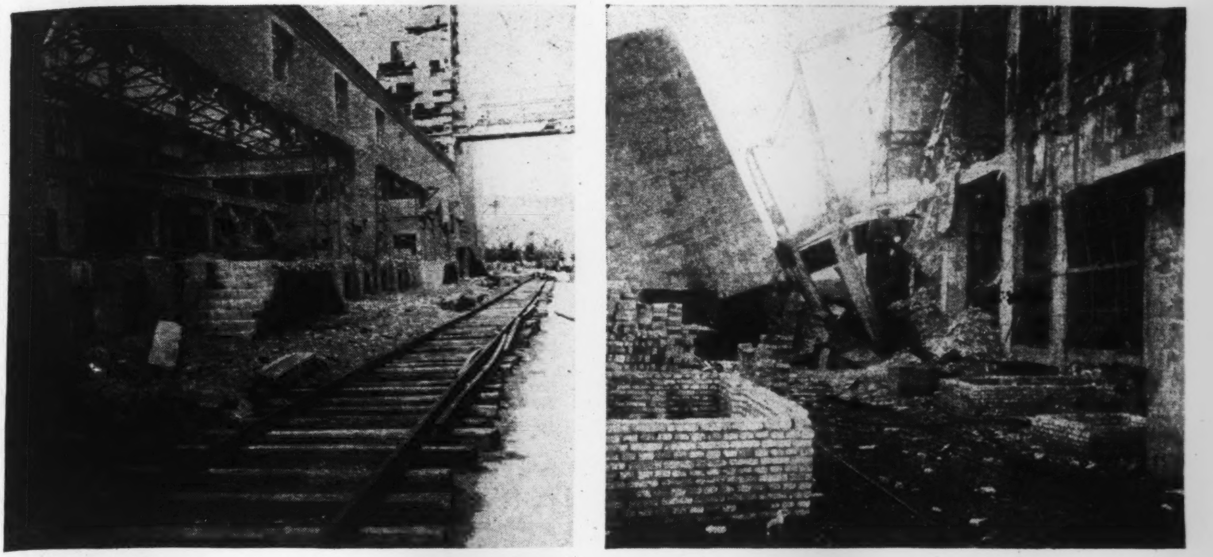


Fig. 8. Wrecked buildings that must be repaired. Left, walls of cement plant knocked out to permit removal of equipment to railroad cars brought in on temporary track. Right, demolition charges in a boiler of the power station at the Penchihu-Manchu Iron Works blasted walls and framing as well.

etc., will have to be replaced before any substantial production can be secured. Probably a million dollars would be required to replace the necessary missing items that would allow the production of one-half million tons of pig iron per year.

At Changch'un the large railroad repair shop of the South Manchurian R.R. was completely stripped. On the other hand, the gas works suffered mainly from neglect. At Kirin the electro-chemical plant lost its carbide electric furnaces and coke oven accessories. The synthetic rubber plant was completely stripped. The large Asano Cement Co. plant was relieved of its materials handling and sizing equipment as well as electric accessories. All of the equipment of two small saw mills was removed. The large synthetic petroleum plant was treated similarly.

And so on the story went throughout the Nationalist territory which was completely open to us. But in the Communist territory the story was not much different. One cement plant at Harbin, reportedly Russian-owned, was intact. On the other hand, another cement plant at Mutanchiang, of which we had found a record in Japan, apparently had disappeared. We were informed by the Japanese that all of the equipment had been removed.

The large railroad equipment plant located at Mutanchiang had been stripped of nearly all machine tools. This plant had obviously been in the line of fire during the most determined stand the Japanese Army made against the invading Soviets, and most of the buildings were destroyed. We were told that the Japanese had removed machines before their retreat, but if that was the case, they merely had saved the Soviets the trouble of loading them.

The Manshu Kiki plant in Harbin, where construction equipment had been made, had lost all of its machine tools and some of its foundry equipment. The Harbin steam-electric generating station was apparently in operable condition, but was not being operated because insufficient power was coming from the remaining generators at the Tafengmen hydro plant in Nationalist territory! We also found a woolen mill here in the process of being removed by the Chinese Communist Army.

Great reconstruction job ahead

What can be done with Manchuria to make it an asset is a difficult problem. Had it remained as the Japanese left it, it could have supplied much of the steel, machinery, and other materials required for the building of industries and public works in the remainder of Asia. As it is now, the best that can be hoped for some years is that Manchuria will be able to supply coal, pig iron and a few other industrial raw materials.

Everything constructive in Manchuria awaits the end of the Civil war, which so far has been very destructive. When that end comes, the opportunities for construction and process engineers will be tremendous. Moreover, it will take a long time because so much of the credits for expansion will have to be foreign and because many of the basic industries can only come back slowly.

Greater China and Korea will need much of the industrial equipment which will become available as reparations from Japan because this can be obtained without a drain on meager foreign exchange balances. Labor and building materials can be supplied locally through internal credits. But all that is not enough. Additional equipment and much technical talent will be needed. While I have nothing but praise for the young Chinese engineers I met, many of whom were educated and trained in the United States, China does not have an adequate number with the accumulation of knowledge and experience required for the job that has to be done if Asia is to be saved from chaos. American engineers who are sufficiently experienced to be able to make quick decisions, but who are flexible enough to improvise, will be needed in order to adapt American methods to an economy which of necessity will have to be decentralized.

Meter Control of Water Softening Process

Ross A. Thuma
Superintendent of Filtration
St. Paul, Minn.

***Contents in Brief**—Continuous control of chemical additions in the water-softening process not only insures efficiency of treatment but can effect substantial economies. Results obtained with a pH indicating recorder at the St. Paul filtration plant show that plant capacity is increased, sludge-settling characteristics are improved, recarbonation capacity is restored and the quality of finished water is bettered.*

THE PROBLEM of controlling the application of chemicals in the water softening process has been, at best, a tedious task. It requires continuous repetition and then determines the condition of the water only at intervals of test. Consequently, the practice has been to apply ample amounts of chemicals for the purpose of insuring complete reactions and to follow with an agent to neutralize the excess. This procedure of course, is uneconomical and inefficient. During the past few years a system for obtaining continuous pH measurements automatically has been found helpful at St. Paul.

In the lime softening process four factors must be evaluated: (1) quantity of water under treatment; (2) chemical components of the water; (3) quality of the lime used; and (4) equipment provided to weigh the lime as it enters the water. To insure that the process will be economical and efficient, these factors must be controlled accurately and constantly.

Ordinarily, this control job calls for taking samples and making analyses at fixed intervals. At best, 30 min. will be required to make a single examination. Furthermore, since samples are altered by time and by analytical procedure, they do not represent exactly the conditions that obtained when taken. This procedure, executed with speed and care, will provide control for the softening process. However, at St. Paul this requires the services of three analysts and a relief assistant when the plant operates on a 24 hr. basis.

On the other hand, the indicating meter gives the pH of water continuously. In its action, this instrument evaluates the end reaction of lime and water, and shows the point at which the proper amount of lime has been added for effective softening. Furthermore, as only the essential reaction of lime and water is analyzed, the considerations of quantity of water, weighing equipment, and quality of lime are eliminated from the control picture. This statement is not intended to infer that scales and meters are unnecessary but merely that the accuracy of the process is not dependent upon these devices when pH metering is used. In addition to its control of the application of lime, the pH meter may be used to indicate the amount of carbon dioxide required for stabilization of the water.

Description of instrument

The pH indicating recorder is essentially a potentiometer, which measures the electromotive force in a liquid and records the measurement directly in pH units. The assembly consists of three parts: electrodes of the immersion type, an amplifier, and a recording unit.

It is a very sensitive device. To insure continuously accurate results, the operation should be checked once a day by comparing a standard pH measurement with that of the indicator. A series of such examinations will reveal the period at which the electrodes should be cleaned, a factor that varies considerably in different localities. Complete servicing of the instrument takes from 15 to 30 min. a day, and is best handled by training one operator and assigning him this task.

In using the meter for water softening treatment, a pH value is selected by the normal procedure to produce the desired final effluent. Then, the feed machines are adjusted at definite intervals or as required to maintain the desired pH value.

Daily capacity increased

Previous to the installation of this instrument in the St. Paul softening plant, scales controlled the application of lime within five percent of the machine setting. At all times sufficient lime was delivered to remove peak hardness. Consequently, considerable amounts of lime were wasted. This called for recarbonation for removal, or, if retained, built up hardness in the finished water. One consequence was a demand upon the recarbonation equipment which exceeded its capacity. Moreover, the system utilizing weighing equipment permitted a maximum flow of 30-35 mgd. whereas with a pH meter guiding the process, the capacity was increased to 55-60 mgd.

Another favorable result of pH control is that when variations in the quality of lime are revealed, they may be readily compensated for. A dip on the recording chart warns of the introduction of low-grade lime and immediately attracts the attention of the operator who then adjusts the chemical feed machine to bring the pH value to the established limit. Such variations in quality are not discovered when scales are the sole means of control.

With the use of pH control, corrections in application of chemicals are made on an average of every 20 min.—29 min. for the minimum and

9 min. for the maximum flow. Furthermore, a variation of 25 lb. per mg. will be indicated by this instrument—that is, an application of 2,000 lb. per mg. can be measured to $1\frac{1}{4}$ percent accuracy.

Some other effects

Another effect of the accurate application of lime is that the characteristics of sludge are improved. The floc settles more readily and the sludge is more compact. Formerly, total solids in the clarifier sludge approached a maximum of 12 percent; when pH control is employed the concentration is about 15 percent. This improvement in sedimentation has reduced deposits on the filter sand grains.

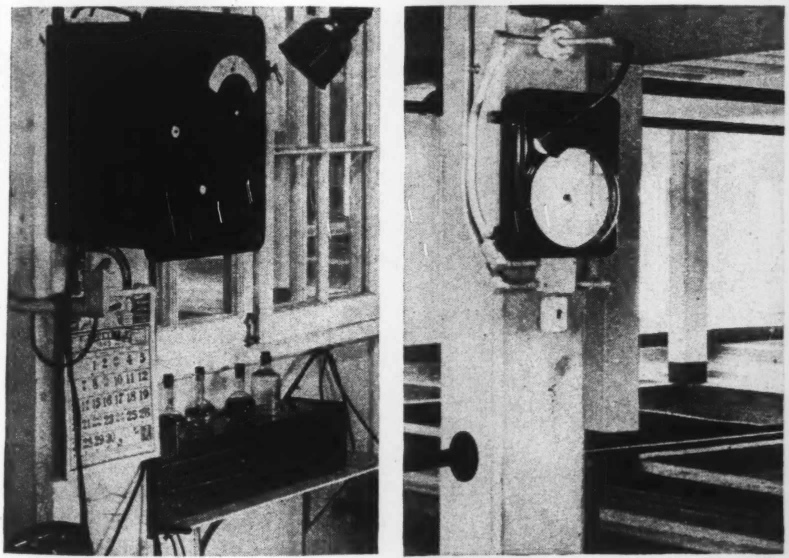
Characteristics of organic matter are often affected by a change in pH that produces distinctive odors, particularly in combination with chlorine. A device, such as the pH meter, scientifically insures that disturbing odors, normally caused by erratic variations in the chemical process, will not be created. Hence, the finished water leaves the plant with an improved quality.

During some periods of the year mild musty or woody odors develop in water that has been stored in a distribution system. This condition, it is believed, is caused by the variation in pH that affects the filmy deposits on the interior of pipe lines. The writer believes that the problem of eliminating such odors will be greatly simplified when uniformity in pH control has been attained.

The use of the pH meter is a definite asset to plant operation. Control of the water softening process is simplified and streamlined to the great benefit and relief of the nontechnical operator. With the indicator as his guide, the worker merely adjusts the chemical-feed machine to maintain the predetermined pH value. If he discharges his responsibility with dispatch and regularity, his job is well done, and done without the necessity of consulting the chemist. The experience of the St. Paul plant indicates that the operators maintain the designated pH value from 75 to 90 percent of the time.

In summation, the advantages of the pH meter are many. They include: accurate control of the application of chemicals, an increase in the capacity of the recarbonation equipment, and a decrease in the amount of carbon dioxide used in the recarbonation process produce important economies. Furthermore, close control of the feeding of chemicals improves the quality of sludge, diminishes filter deposits, and enhances the quality of the finished water. From the viewpoint of the operators, this scheme simplifies the adjustment of chemical-feed machines, minimizes the tedious work of chemical analysis, and by providing a continous accurate measurement of pH definitely aids plant operation.

Direction of the St. Paul Water Department is conducted under a board of commissioners consisting of: William A. Parranto, president, John S. Findlan and Sevrin Martinson. Bernard T. Holland is deputy commissioner and Leonard N. Thompson is general manager.



Photos by The Bristol Co.

Instantaneous readings of pH are obtained from indicator (left), which may be installed in any convenient location. At the right is a recorder mounted in the filter plant to provide a continuous, visual and permanent chart of pH variations. If desired the indicator and recorder may be obtained in a single unit mounting.

Cleaner Cities Based On Ordinance Enforcement

No real progress toward bettering the appearance and the sanitation of municipalities can be realized until there is more universal compliance with existing ordinances and a material change in the careless habits of a large portion of the citizens. This is the conclusion reached by the street-cleaning committee of the American Public Works Association.

The failure to bring about permanent improvement is attributed by the committee to the lack of properly implemented long-range year-round programs. While spring clean-up campaigns have served a good purpose, it is emphasized that they have singularly failed to produce lasting results and by their very nature have seemed to foster year-round carelessness. In recent years many cities have begun to realize the importance of the "year round approach" and have instituted programs of education and enforcement on that basis.

Helps are available

It is recommended that all cities take a prompt initial step toward municipal cleanliness and sanitation by establishing a permanent joint committee or council made up of ranking officials of the various departments of government concerned with the problems of maintenance, education and ordinance enforcement.

The committee, of which William A. Xanten, superintendent of the city refuse division, Washington, D. C., is chairman, has filed with the American Public Works Association headquarters at 1313 E. 16th St., Chicago, a reference file of data to be used in answering inquiries on this subject.

Vertical Sand Drains Speed Consolidation Of Soft Water-Bearing Subsoil

***Contents in Brief**—California has pioneered in the development of vertical sand drains to expedite subsurface soil consolidation. Drains are simply vertical sand columns placed by driving and cleaning out a pipe casing, then filling the hole with sand as the casing is withdrawn. On the Terminal Island Access Freeway in the Los Angeles area, some 3,600 drains 21-in. in diameter have been installed at an average rate of twenty 40-ft. deep columns per 8-hr. shift by use of a double-walled tube with 24 water jets at the bottom. Specially devised but simple and economical equipment indicates pressure and movement within the fill.*

THE CONSTRUCTION of vertical sand drains for the Terminal Island Access Freeway project in southern California required the development of special equipment for the particular subsurface conditions on this job. Sand drains or sand "piles" are used on this work to provide escape for water and thus accelerate subsurface consolidation. The most successful new equipment, as indicated by progress records, was developed by the Macco Construction Co., Los Angeles, and involves the use of a pipe or tube some 62 ft. long that has double walls and at the lower end has 24 water jets that operate under 200-psi. pressure.

Another feature of the work on this freeway project is the use of controls by state engineers to minimize lateral displacement while fill material is deposited over the sand drains. These controls involve the measurement of internal pressure of the fill at various depths by a "pore-pressure apparatus" and measurement of the amount of settlement in the fill by settlement platforms. Control of the fill work is necessary to safeguard nearby oil wells and transmission towers.

The Terminal Island Access Freeway project when completed will provide quicker and more direct access between vital naval and industrial installations on Terminal Island and the cities of Long Beach and Los Angeles.

Construction under way by the state includes freeway sections through Long Beach oil fields and grade-separation structures over railroads and streets. This work requires fill on wet or marshy ground. Fill is of nominal depth, becoming deep at the overpass approaches. To support even a nominal depth fill at this location with a minimum of lateral displacement, sand drains were used to accelerate consolidation and thus increase the bearing power and stability of the soil.

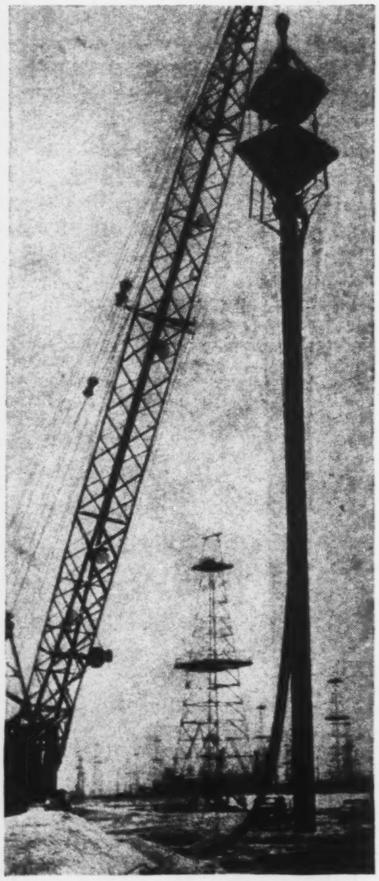


Fig. 1. A 62-ft. jet pipe suspended from crane preparatory to sinking sand drain on the Terminal Island Access Freeway project.

Sand drains remove water

The use of sand drains has been developed in recent years, principally on the West Coast. The present procedure was developed following studies in 1933 on pore pressures observed in the foundation under the fill on the east bay approach to the San Francisco-Oakland Bay Bridge. Work on this and other California projects under supervision of O. J. Porter, until recently with the Division of Highways, further perfected the procedure. During the recent war the Navy made extensive use of sand drains in work at Mare Island and Port Chicago on San Francisco Bay, retaining Mr. Porter as consultant. Several state highway projects in California now under construction use sand drains for the accelerated and controlled settlement of fills over marsh land or other unstable foundation.

The extent of the use of sand drains in California is indicated by the fact that more than $300,000 will be spent on their construction in a single contract. This contract, the largest ever let in that state for highway work, is for $2,993,000 for construction of a section of the Bayshore Freeway between South San Francisco and Burlingame, Calif. This work is being done as a joint venture by the Macco Construction Co. and the Morrison-Knudsen Co., Inc.

Briefly, the use of sand drains as developed in California involves the following: Holes, 18 to 22 in. in diameter, are drilled or bored 30 to 60 ft. deep and filled with porous material graded from coarse sand to fine gravel. These holes are spaced so that each drains an area of 100 to

400 sq.ft. The diameter, spacing, and depth of the holes depend on local conditions as determined by test borings, the height of the fill, and the depth to hard strata.

Sand permits water escape

A blanket some 2 ft. thick of the porous material is placed over the top of the sand-filled holes and extended out to beyond the point where the toe of the fill will be located. Thus, an easy avenue of escape is provided for subsurface water forced out as the fill is made. To further accelerate the removal of water, a surcharge load of 5 to 8 ft. of earth may be temporarily placed over the fill.

When properly used and controlled, these sand drains accelerate ultimate settlement of fills by rapidly draining entrapped water and thus permitting immediate consolidation of underlying material with a minimum of lateral displacement. This avoids the need for obtaining settlement by building fills long in advance of finish work or the use of large excess fills or surcharge. By so doing the fill is made available for paving in a relatively short time.

Specifications for work on California's highways do not stipulate methods of opening holes for sand drains; this is the contractor's responsibility. Thus, procedures developed vary considerably. Some contractors have used rotary buckets, essentially earth augers, and others have used open or closed mandrels with or without a jet.

State specifications for this work include the following provision: "The holes may be excavated by cutting or augering out the material, by jetting a casing down to the required depth, by driving with a piledriver and plugged mandrel, or by other approved methods."

The "plugged mandrel" method has been used as much as any, including use on wartime work at Mare Island Navy Yard and, recently, on parts of the Bayshore Freeway. Piledriving equipment is used to drive a mandrel or tube with a plate covering the lower end. This plate is attached so that it will swing free as the mandrel is pulled out. When the proper depth is reached, a hopper is placed over the open end of the mandrel to fill it with sand. Then as the mandrel is withdrawn, the sand fills the hole and the cover plate swings free. Using this method the Piombo Construction Co. of San Francisco, on some of the Bayshore Freeway work, completed as much as 2,000 lin.ft. of sand piles per day.

Tube with 24 jets

Conditions on the Terminal Island Access Freeway work were such that methods developed on previous work could not be used. Sand lenses or pockets in the otherwise soft material could not be worked through successfully except by modifying existing methods. Of the several contractors on this work who had sand drains to install, the Macco Construction Co. has developed the method that has given the greatest lineal footage per day.

The "Macco" method involves the use of a tube or casing with double walls and 24 jets at the bottom. A 62-ft. tube is made up of two steel pipes, a 16-in. dia. pipe is fitted inside one of 19-in. dia., the two pipes being conected at each end. At the bottom, the outside pipe extends some 10 in. beyond the inner one to form a cutting edge.

The connection between the two pipes at the lower end consists of a flat steel annular ring in a plane normal to the pipe center line. Mounted in this connection are 24 jet nozzles formed of lengths of ¾-in. diameter pipe about 2 in. long. Each third jet is directed at an angle toward the center line of the jet tube and the remainder are directed straight down. Thus 16 nozzles jet down and 8 jet toward the center line.

Air and water jets

The upper end of these pipes is fitted with a casting to which a water hose can be coupled (Fig. 2) so that water under a pressure of 200 psi. can be forced down the shell of the tube and out the jet holes. The casting is equipped with three lifting fins for moving the jet pipe.

The tube is placed in a vertical position at the required location and jetted to the desired depth. Loosened material rises through the center and spills over the top. Sluicing is continued until the water discharged contains less than two percent of silt or clay.

To aid in cleaning out loosened material, compressed air under 100 psi. pressure is forced in through two 1½-in. dia., pipes one of which

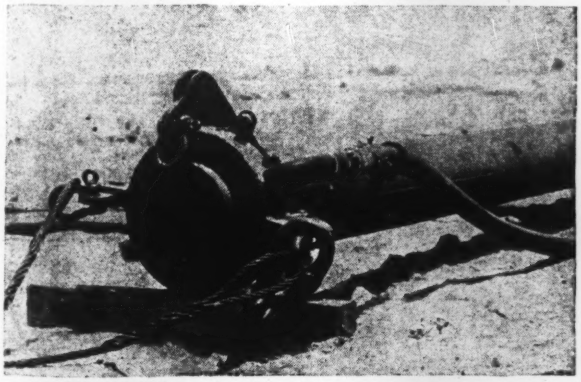


Fig. 2. The top of the pipe was fitted with a heavy casting that distributed water under 200-psi. pressure in the hollow shell of the tube. Three fins on the casting provide for lifting the jetting tube.

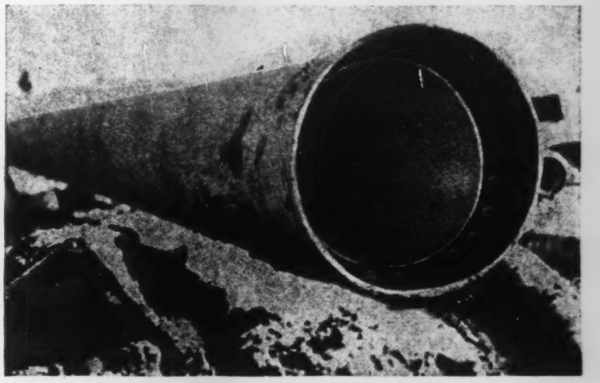


Fig. 3. Cutting edge of the jet pipe. Jet nozzles (retouched in this photo) are ¾ in. in diameter and are set some 10 in. back from the cutting edge in the annular ring closing the space between the 16 in. and 19 in. dia. pipes.

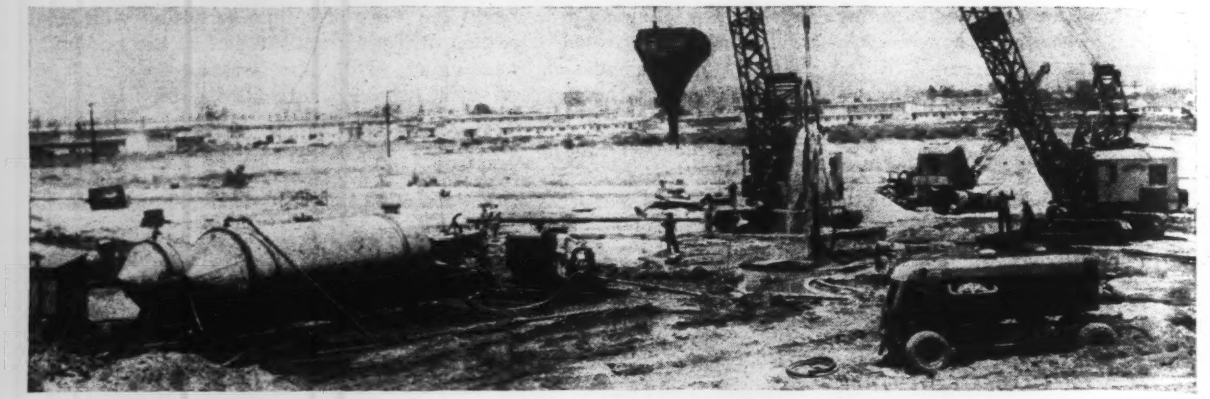


Fig. 4. When the sand drain installation was started, one crane handled the casing, one the hopper and air jet while a third was used to handle sand. The tanks at the left were used to equalize the water supply.

is attached to each side of the outside of the jet tube assembly. These air pipes extend from the top of the assembly to a point some 2 ft. from the cutting edge. No special nozzles are used in connection with air delivery.

At first these air-supply pipes were attached on the inside of the entire assembly. However, better results were obtained by the outside attachment and also cleaning the air pipes was easier.

When the required depth is reached and the water forced out at the top of the tube is satisfactorily clear, sand is introduced into the tube by means of a hopper attached at the top. As the tube is withdrawn, the sand fills the hole. This part of the Macco method is similar to the "plugged mandrel" method previously described.

Using these methods, the Macco firm maintained an average of some 20 drains a day. Their maximum progress was 35 in one day, or 1,400 lin.ft. Although the jet assembly has an outside diameter of only 19 in., the resulting sand columns average some 21 in. due to movement of the pipe and over-excavation from jet action.

One crane does work of three

When the Macco sand drain installation was started three cranes were required, one to handle the casing, one for the hopper and the air jet, and a smaller wheel-mounted crane to load sand into the hopper. The process was later perfected so that one crane was adequate. To accomplish this the hopper was securely attached to the casing so that the entire apparatus could be moved together. The hopper was fitted with a trap door which was opened while the casing was being sunk to allow water and mud to flow out. A short ladder was welded to each side of the hopper so that it could be mounted and the crane bucket quickly attached or detached.

Perforated plate makes jet

A second contractor on this freeway work, the James I. Barnes Construction Co., Los Angeles, developed a jet tube consisting of a pipe some 18 in. in diameter with a plate welded over the lower end. The plate was perforated to form the jet holes and water was forced into the pipe at the top. This jet tube was inserted in a casing with an allowance of some $1\frac{1}{2}$ in. between the casing and the tube. The jet loosened material and forced it up in the space between the casing and the tube. In order to fill the holes thus made with sand, the jet pipe was removed and the sand was placed in the casing by means of a separately handled hopper. The casing then was pulled out.

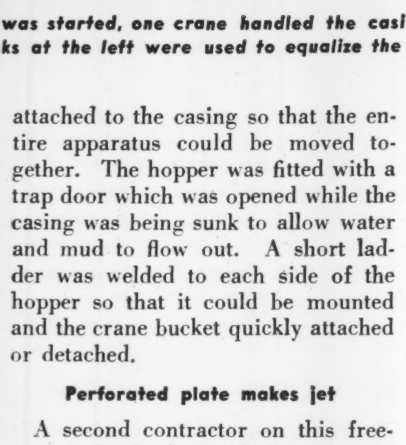


Fig. 5. Another jetting method employed on the project involves the use of this 18-in. diameter pipe. Jet action is accomplished by water forced through holes drilled in a plate welded over the lower end of the pipe.

Maximum progress on the Barnes work was 16 drains completed in a 10-hour shift. As the average drain was 40 ft. deep, this represented 640 lin.ft. as compared to a maximum of 1,400 ft. on the Macco work.

However, conditions on the Macco work and the Barnes work varied considerably. For example, Macco had many more sand drains to install than Barnes did and thus it was to Macco's benefit to spend more time perfecting an efficient method. Another difference between the Barnes and the Macco contracts is that these production figures cover all of the Macco job and only the first half of the Barnes work.

Close control of fill

Fill placed over sand drains was closely controlled by state engineers by the use of a pore-pressure measuring device (Fig. 6) and a fill-settlement platform (Fig. 7). The pore pressure apparatus consists of a wellpoint placed in the fill at the location of the desired pressure. This wellpoint is connected by means of copper or plastic tubing to a gage and an air cock, both mounted on a timber supporting post placed in the

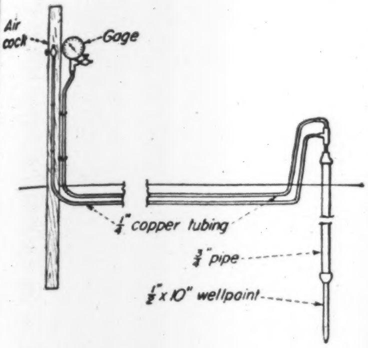


Fig. 6. This simple apparatus was used by state engineers to determine the pressure at various points below the fill as the work progressed.

ground outside the limits of the fill.

To get an initial reading on the gage, water under low pressure is introduced into one line and circulated until all entrapped air and gases are removed from the system. The lines are then closed and, after the pressure in the system reaches equilibrium, an initial reading is taken. Subsequent readings, if different from the initial reading, reflect pressure changes in the fill.

If, in the course of placing fill, the pressure in the soil below the fill increases either too sharply or too much it is an indication that the water is being forced out of the soil faster than it can be removed by the sand drains. In such case, the filling is stopped until the pressures are sufficiently reduced.

Settlement determination

Fill settlement platforms, some 3 ft. wide by 4ft. long, are made of 2x12 boards. Pipe risers about 5 ft. high are mounted in the center of each platform. Attached to these risers are tubes leading to overflow cups some 2 in. in diameter. Mounted on the end of the risers are covers which protect the overflow apparatus, which consists of a wide-mouth quart cans or the equivalent. Outside the limit of the fill, mounted on posts, are glass tubes connected by short sections of rubber tubing to the copper or plastic tubing that extends to the fill platforms.

When it is desired to measure the amount of settlement in the fill, a small amount of water is poured in the open end of the glass tube to make sure the system is filled. When the water in the glass tube reaches a stable elevation, the elevation is noted. This, when compared with an initial elevation reading for this platform, gives the amount of the settlement of the fill. These platforms are left inside the fill after the work is done.

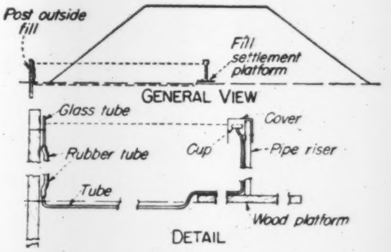


Fig. 7. Settlement inside the fill was determined by a water-level device connected between platforms constructed inside the fill and posts outside the fill.

By use of these two measuring systems, state engineers are able to regulate the fill work so that no appreciable damage is done by soil movement to nearby oil wells or transmission line towers. State officials are well satisfied with results obtained by use of these methods on the Terminal Island work and describe the control of the fill as being "just about perfect."

Construction on the Terminal Island Access Freeway project is under the direction of S. V. Cortelyou, district engineer for the state Division of Highways, and F. B. Cressy, district construction engineer. Control methods were developed under the direction of T. E. Stanton, materials and research engineer for the state Division of Highways. On the Macco contract, George Langsner is resident engineer for the state and G. F. Winslow represents the state's materials and research department. Earl Purcell is superintendent for the Macco Construction Co. on the project.

Asphalt in Concrete Makes Soft Mix That Increases Floor Comfort

Recently announced for public use is a new type concrete floor, called Comfort Concrete, which absorbs more impact than regular concrete. It should increase the use of hard floors where the fatigue effect of regular concrete is a problem.

Developed by the John B. Pierce Foundation Buildings Materials Department under F. O. Anderegg, the new material is offered as a service to the public by the foundation, a housing research organization. By adding asphalt emulsion to regular portland cement, a mix was developed that absorbs 90 percent of impact and is considerably drier and warmer than regular concrete. Tests in a calf barn revealed that it stays within 5 degrees of the room temperature.

Used experimentally in farm buildings, shops, laboratories, and a small factory, the new flooring has stood up well. Tests have proved that its wear resistance is about equal to that of maple flooring.

High penetration asphalt has been found the desirable grade for mixing into portland cement concrete for floors. Asphalt with an air-entraining emulsion, so that concrete is slightly porous, is most satisfactory.

A typical batch for one cubic yard of comfort concrete is: 2,000 lb. crushed stone, passing a ¾ in. screen but retained on a ⅜ in. screen; 1,800 lb. manufactural sand or 1,600 lb. natural sand passing a 1.4 in. screen; 376 lb. (4 bags) Type I, ordinary, portland cement and 7 gal. asphalt emulsion of which 10 percent should have air-entraining properties.

The asphalt retards the strength gain of concrete at early ages but the "4-bag" concrete with asphalt compares favorably with 1:2:4 straight portland cement concrete.

Comfort Concrete costs about the same as concrete to mix or lay, and no special tools are required. There is no restriction on use of Comfort Concrete.

A booklet describing the mixing technique, placing procedure, and structural data is available at a charge of 35 cents from the John B. Pierce Foundation, Joseph F. O'Brien, executive director, Raritan, New Jersey.

How An American Sanitary Engineer Is "Selling" Water Systems in China

***Editor's Note**—Among those sanitary engineers who have distinguished themselves in promoting environmental sanitation practice in foreign lands is Arthur B. Morrill, who has served in China since 1941 on an assignment from the U. S. Public Health Service. No stranger to the problems of that country—having been a professor of sanitary engineering at the Pei Yang Government University in Tientsin from 1911 to 1914—Mr. Morrill's efforts are commanding sympathetic interest and support. Latest word on his activities is contained in a despatch from Tillman Durdin of* The New York Times *staff dated Feb. 2, and which is published here by special permission of the* Times.

Arthur B. Morrill

SINING, the bleak and dusty little uplands capital of China's far-western Chinghai Province, is soon to become the first city in the slab of territory stretching 2,000 miles across central Asia to have a piped municipal water supply.

Sining's city waterworks will be mainly the result of the missionary efforts of a tall, silver-haired earnest 59-year-old American sanitary engineer named Morrill, whose job it is to roam around China promoting health and progress through modern water and sewerage systems.

Arthur B. Morrill is a colonel in the United States Public Health Service on loan from the government as a sanitary engineer for the city of Detroit. For the last two years he has been maintained in China by the cultural relations division of the State Department to encourage Chinese in developing municipal sanitation.

His easiest task

Selling Sining a new-fangled water system was the easiest and the most adventurous and interesting mission that Colonel Morrill has carried out in this country so far.

Last spring the American public health emissary concluded the satisfying task of getting Lanchow, ancient walled capital of Kansu Province, all lined up for a new piped water supply. He had heard much of the exotic attractions of the great Tibetan lamasery of Ta Erth Ssu, 200 miles west of Lanchow, and decided to visit the place.

En route Colonel Morrill stopped at near-by Sining. The city health commissioner, a modern-minded young man from the Shanghai area, came to see him and told him about a typhoid epidemic that had taken a heavy toll in Sining a short time before. The health commissioner mentioned the possibility of a piped water system for Sining.

Colonel Morrill became immediately enthusiastic and made some quick calculations as to costs. The two men then went to see Chinghai's swashbuckling, mustachioed Governor General, Ma Pu-fang, who rules Chinghai with a stern but sometimes enlightened despotism. The American engineer gave Ma his gospel of health through modern sanitatary measures.

"He caught on immediately," Colonel Morrill reports. "He never blinked an eyelash at my cost figure of $150,000 (United States) for work and machinery. In three nights and two days I had sold the new water system, worked out the designs, visited my near-by lamasery and was on my way back to Lanchow."

Piped water far away

Sining has a population of 60,000, is 700 miles by road from Chengtu, Szechwan, nearest city with a piped water supply. And on the west across deserts and mountains in the heart of Asia, Colonel Morrill calculated, you do not come across another piped water system until you hit Kabul, lofty and remote capital of Afghanistan, nearly 1,500 airline miles away.

Colonel Morrill finds the present high cost of labor in China as a big inducement for cities to install water and sewerage systems.

"Urban residents are finding that getting water through a pipe costs a fraction what it costs when brought in buckets by coolies from wells or a river," Colonel Morrill says, "but we have to soft-pedal the clearness and purity angle because in some cities people have a prejudice against clear well water and prefer muddy river water. In Chungking coolies selling purified water by bucket from a water pipe had to put mud in it before the people would take it."

Surplus Equipment Returning from China

The Chinese government has announced employment of several U. S. construction companies to inventory, assemble and pack for shipment some $584,000,000 of surplus war equipment bought from the United States.

China got the surplus—much of it construction machinery and supplies—in a "grab-bag" deal whereby it took possession of the materials "as is, where is." The locations include Guam, Okinawa, Saipan, Tinian, Iwo Jima, Kwajalein, Los Negros, New Guinea, Wake, Eniwotok, Makin and Marcus islands. China is to remove all the surplus it can use for its reconstruction, and will sell the rest to interested foreign buyers. The dumps purchased include heavy construction equipment, automobiles, tires, plumbing supplies, and shelters.

Comment and Discussions

Readers' opinions on matters that concern engineers and contractors

Poor Choice of Picture

Sir: In your Dec. 19, 1946, issue, vol. p. 828, there is a picture which purports to show building operations on a new Ford Motor Co. plant at Hapeville, Ga. The caption under this picture states that a new building technique was used in the construction of this building in that the floor was completely poured before steel erection was started. A close inspection of the photograph reveals the fact that no poured floor is in view; in fact, it appears that the level man in the foreground is setting grade stakes for finish grading and practically all of the structural steel has been erected.

The technique is hardly new, but was used to my knowledge as early as 1940 at the San Diego plants of Consolidated Vultee Aircraft Corp. The procedure of pouring floors ahead of steel erection was followed almost entirely during the construction of Plant 2 for Defense Plant Corp., and in one building a 4,500-ton press was completely installed on its foundation and put into operation inside a temporary enclosure previous to the erection of steel.

JAMES M. KITE
Plant Engineer
Consolidated Vultee Aircraft Corp.
San Diego Division, Calif.

The section of the plant in which the picture shown was taken was the only one where the floor was not poured in advance of steel erection. —EDITORS

Beam Deflections

Sir: With reference to the article "Beam Deflections Under Combined Loads," by F. A. Wallace (*ENR* Jan. 9), the writer has found the computation of beam deflection by use of the buckling load to be very expeditious. By this concept, the center deflection of a simple beam uniformly loaded is equal to the bending moment at the point divided by the buckling load of the beam for the corresponding configuration of the axis, or 9.6 EI/L^2. To obtain the center deflection under a concentrated load 0.8 of the moment at the point is divided by the same buckling load, and to obtain the center deflection resulting from an end moment, 0.6 of that moment is divided by the buckling load.

When the beam is also subjected to an axial load, the above buckling load is reduced by the amount of the axial load if it is compressive, and the buckling load is increased by the amount of the axial load if it is tensile. The same concept has been applied by the writer to the computation of deflections and correction for deflection effect in arches and suspension bridges.

Computation of the deflection of the beam given in the article by use of the buckling load resulted in a combined deflection of 0.285 ft., as compared with that of 0.284 ft. given by the author. If the Euler buckling load is used, the combined deflection becomes 0.277 ft.

C. H. GRONQUIST
D. B. Steinman, Consulting Engineer
New York, N. Y.

Curling of Concrete Floors

Sir: While Prof. Morrison's explanation of the curling of concrete floors is correct (*ENR* Jan. 9), it is not necessary to be familiar with the theory of elasticity to demonstrate its truth.

The following simple experiment, shown to the writer by Frank N. Kneas, enables one to see " . . . that the corners of the plate have a tendency to rise up under the action of the applied load . . . " and at the same time contrasts the strengths of one-way and two-way concrete slabs. The only materials required are a sheet of bond paper 8½x11 in., a frame or box about 6x10 in. and some small coins.

A model of a one-way slab can be constructed by placing the paper over the frame with the 8½-in. dimension of the paper parallel to the 10 in. dimension of the box. A very few coins placed at the center of the span will cause "failure" of the slab. Rotating the paper through 90 deg. makes a model of a two-way span simply supported on four sides. The number of coins which can be supported by this model is considerably greater.

As the two-way slab model is loaded it will be noticed that the corners of the paper rise up from the frame. This deformation increases with increasing load until failure occurs.

WILLIAM SUSSMAN
New York, N. Y.

Engineer Congressmen

Sir: May I take this opportunity to commend *Engineering News-Record* for bringing to the attention of the engineering profession and construction industry the fact that they are represented in the Congress of the United States by Hon. George W. Malone, Nevada, a registered civil engineer in the State of California, who was elected to the Senate at the last election.

It is noted in the article that your writer states: "One civil engineer—Representative Carl Henshaw, Pasadena, California—who represents the profession is a member of the House of Representatives." Your writer overlooked another California civil engineer who is a member of the House of Representatives, and if I am not mistaken this is his second term. I refer to Honorable George P. Miller, Alameda, representing the Sixth Congressional District of California.

PECOS H. CALAHAN
Executive Secretary
Calif. Bd. of Registration For Civil Engrs.
Sacramento, Calif.

Constructive Labor Actions

Sir: I have just read the article and editorial which appeared in *Engineering News-Record* (Nov. 21, 1946, vol. p. 692 and Nov. 28, 1946, vol. p. 708) covering the action of the Metal Trades Department on jurisdictional disputes.

It occurs to me that if some of the efforts made by the labor movement toward constructive settlement of internal difficulties, and their results, were made public to employers in the manner which you have followed, a closer understanding would result.

JAMES A. BROWNLOW
Metal Trades Department
American Federation of Labor
Washington 1, D. C.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Rebuilt Truck Used Widely On Maintenance Work

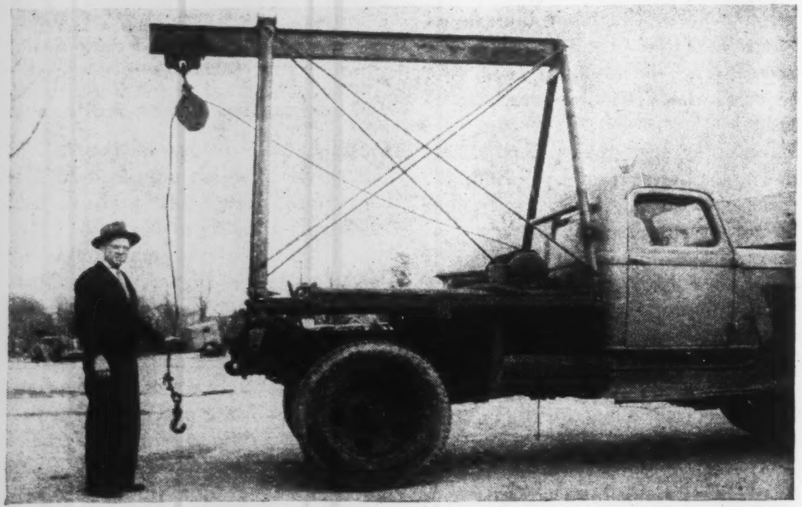
Maintenance crews of the Laurel district of the Maryland State Road Commission are finding frequent use for the special truck illustrated by the accompanying photograph. New assignments are always arising for the rig.

To make the unit a 2½-ton dump truck was rebuilt. The double A-frame provided was built of old steel pipe formerly used to attach a snow plow on trucks. The frames are pin connected to the body and are of welded construction, the method of attachment permitting the frames to be moved quickly if desirable. The steel I-beam at the top of the frames is 8-in. deep.

Mounted behind the cab is a hoist powered by the truck motor and equipped with 300 ft. of ½-in. dia. steel wire rope. The hoist has two speeds in forward gear and one in reverse. Normally, two bolts passing through the lower flanges of the I-beam retain the trolley at the outer end of the beam, but these bolts can be removed readily if a forward position of the trolley is desired.

The truck has proved especially valuable in pulling guardrail posts, removing trees from the highway, assisting in attaching snowplows to trucks in the equipment yard, and numerous other uses.

The truck was rebuilt under the direction of W. F. McCormick, equipment supervisor at Laurel, who is shown at the back of the truck.

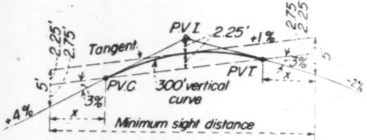


Rebuilt at little cost, this former dump truck is used for many jobs by the highway maintenance crews at Laurel, Md. Equipped with A-frames, hoist and trolley beam, the truck is useful in pulling guardrail posts and removing trees.

Vertical Sight Distances Computed Without Formula

In highway layout, the minimum vertical sight distance when greater than the length of the vertical curve can be found without the use of a special formula from a sketch of the parabola, such as the diagram shown for a 300-ft. curve connecting a +4 percent grade with one of —2 percent.

The tangent to the vertical curve at midpoint is parallel to the chord from the P.V.C. to the P.V.T. Its gradient is $(g_1 + g_2)/2$, or $(4 - 2)/2 = 1$ percent in the illustration, and the change in grade between this chord and the tangents is $(g_1 - g_2)/2$, or $(4 + 2)/2 = 3$ percent. The vertical ordinate at midpoint from the curve to the chord is the same as the center correction, 2.25 ft. If the distance from eye to pavement is 5 ft., the vertical distance to be made up beyond the P.V.C. or P.V.T. is 5 — 2.25, or 2.75 ft. Since the line of sight is on a 3 percent grade, the distance x from the P.V.C. and P.V.T. to the limit of the minimum sight distance is $x = 2.75/0.03 = 91.7$ ft., and the sight distance is $300 + 2 \times 91.7 = 483.4$ ft.—WILLIAM E. COOPER, *Grade Crossings Bureau, Dept. of Public Works, Albany, N. Y.*

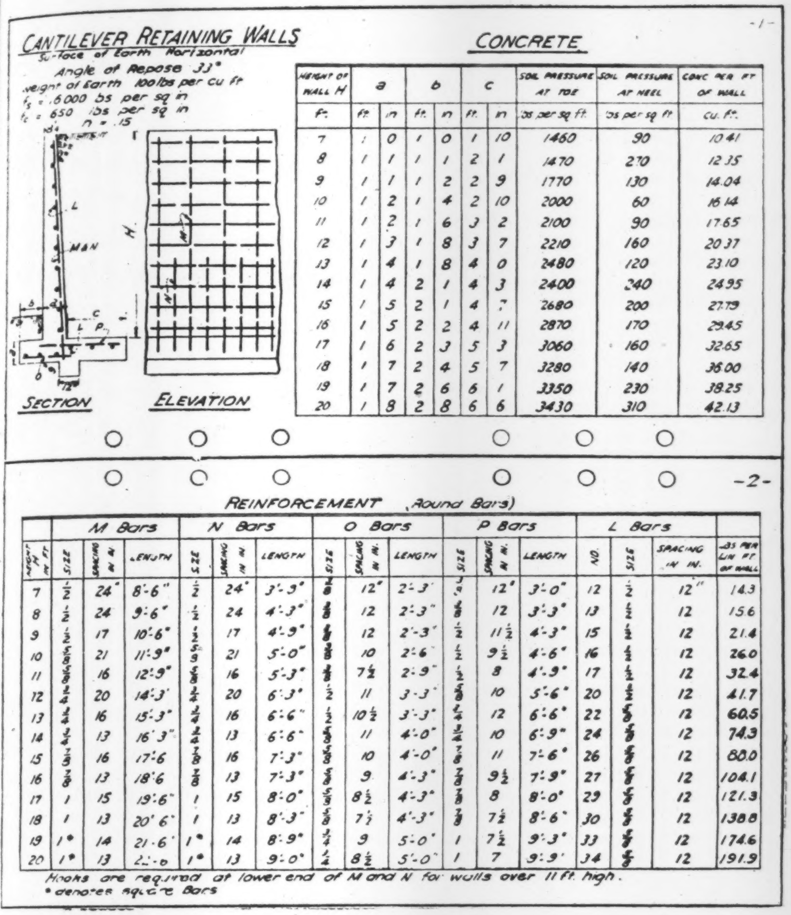


The minimum vertical sight distance can be computed from a sketch of the parabolic vertical curve.

Standards for Low Walls Insure Safe Design

Faced with a wave of new retaining wall construction within the city limits and mindful of the unhappy experience with encroachments and failures of walls built in past years, the city commission of Tulsa, Okla., recently adopted an ordinance regulating this type of construction along public streets. Passage of the ordinance is expected to eliminate future difficulties caused by improper design and construction.

But approval of the plans and issuance of permits for construction of the walls places another time-consuming chore on the already overloaded city engineer's staff. To ease this burden, the accompanying minimum design standards for reinforced concrete cantilever retaining walls between 7 and 20 ft. in height are being made available to all permit applicants without cost. Use of these standards, however, is optional with the applicant, since any design approved by the city engineer may be used. Stand-



-1-
CANTILEVER RETAINING WALLS
Surface of Earth Horizontal
Angle of Repose 33°
weight of Earth 100 lbs per cu ft
f_s = 16000 lbs per sq in
f_c = 650 lbs per sq in
n = 15
L
M&N
H
a
b
c
L
P
12"
SECTION
ELEVATION
-2-

CONCRETE

HEIGHT OF WALL H	a		b		c		SOIL PRESSURE AT TOE	SOIL PRESSURE AT HEEL	CONC PER FT OF WALL
ft.	ft.	in	ft.	in	ft.	in	lbs per sq ft.	lbs per sq ft	cu. ft.
7	1	0	1	0	1	10	1460	90	10.41
8	1	1	1	1	2	1	1470	270	12.35
9	1	1	1	2	2	9	1770	130	14.04
10	1	2	1	4	2	10	2000	60	16.14
11	1	2	1	6	3	2	2100	90	17.65
12	1	3	1	8	3	7	2210	160	20.37
13	1	4	1	8	4	0	2480	120	23.10
14	1	4	2	1	4	3	2400	240	24.95
15	1	5	2	1	4	7	2680	200	27.79
16	1	5	2	2	4	11	2870	170	29.45
17	1	6	2	3	5	3	3060	160	32.65
18	1	7	2	4	5	7	3280	140	36.00
19	1	7	2	6	6	1	3350	230	38.25
20	1	8	2	8	6	6	3430	310	42.13

REINFORCEMENT (Round Bars)

	M Bars			N Bars			O Bars			P Bars			L Bars			
HEIGHT H IN FT	SIZE	SPACING IN IN	LENGTH	SIZE	SPACING IN IN	LENGTH	SIZE	SPACING IN IN.	LENGTH	SIZE	SPACING IN IN.	LENGTH	NO.	SIZE	SPACING IN IN.	LBS PER LIN FT OF WALL
7	½	24"	8'-6"	½	24"	3'-3"	3/8	12"	2'-3"	3/8	12"	3'-0"	12	½	12"	14.3
8	½	24	9'-6"	½	24	4'-3"	3/8	12	2'-3"	3/8	12	3'-3"	13	½	12	15.6
9	½	17	10'-6"	½	17	4'-9"	3/8	12	2'-3"	½	11½	4'-3"	15	½	12	21.4
10	5/8	21	11'-9"	5/9	21	5'-0"	3/8	10	2'-6"	½	9½	4'-6"	16	½	12	26.0
11	5/8	16	12'-9"	5/8	16	5'-3"	3/8	7½	2'-9"	½	8	4'-9"	17	½	12	32.4
12	¾	20	14'-3"	¾	20	6'-3"	½	11	3'-3"	5/8	10	5'-6"	20	½	12	41.7
13	¾	16	15'-3"	¾	16	6'-6"	½	10½	3'-3"	¾	12	6'-6"	22	5/8	12	60.5
14	¾	13	16'-3"	¾	13	6'-6"	5/8	11	4'-0"	¾	10	6'-9"	24	5/8	12	74.3
15	7/8	16	17'-6	7/8	16	7'-3"	5/8	10	4'-0"	7/8	11	7'-6"	26	5/8	12	80.0
16	7/8	13	18'-6	7/8	13	7'-3"	5/8	9	4'-3"	7/8	9½	7'-9"	27	5/8	12	104.1
17	1	15	19'-6"	1	15	8'-0"	5/8	8½	4'-3"	7/8	8	8'-0"	29	5/8	12	121.3
18	1	13	20'-6"	1	13	8'-3"	5/8	7½	4'-3"	7/8	7½	8'-6"	30	5/8	12	138.8
19	1*	14	21-6'	1*	14	8'-9"	¾	9	5'-0"	1	7½	9'-3"	33	5/8	12	174.6
20	1*	13	[illegible]	1*	13	9'-0"	¾	8½	5'-0"	1	7	9'-9'	34	5/8	12	191.9

Hooks are required at lower end of M and N for walls over 11 ft. high.
* denotes square Bars

Design standards for 7 to 20-ft. high cantilever retaining walls give permit applicants in Tulsa, Okla., minimum requirements for city engineer's approval.

ards for walls less than 7 ft. in height have not as yet been promulgated, as the principal difficulty from these walls has been encroachment rather than failure. Dan W. Patton is city engineer.

Moment of Inertia of Rivets Easily Calculated

In dealing with rivet groups, a quick and easily remembered means of determining the polar moment of inertia is as follows: (1). Number the rivets consecutively in a row (1 to 4 of Fig. 1) and number the rows (1 to 3). (2). Add the numbers of the rivets in a row arithmetically $(1 + 2 + 3 + 4 = 10)$. This sum is the section modulus of the row about the X-X axis. (3). Multiplying the section modulus by the distance of the line of rivets farthest from the axis gives the moment of inertia. This multiplied by the number of rows gives the moment of inertia of the group about the axis in question. (4). If the same procedure is followed for the other axis, and the two moments of inertia are added, the polar moment of the entire group results. This value is needed in the design of eccentrically loaded joints.

It is to be noted that this rule applies as stated only if the pitch of the rivets is 3 in. For any other pitch it is necessary to multiply the rectangular moments of inertia by one-third the pitch to obtain the correct result. Rivet areas have been assumed as unity.

For simple rivet groups, such as that of Fig. 1, the rule is of little value. If, however, the group is as complex as that shown in Fig. 2, the saving of time and effort is obvious. The computation is shown in the figure.—Robert H. Chambers, *Structural Designer, The Austin Co., Cleveland, Ohio.*

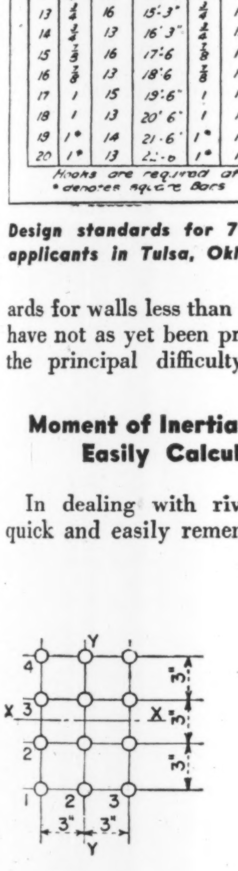


FIG. 1

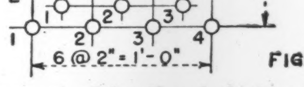


FIG. 2

28 x 4 x 9 = 1,008
21 x 7.5 x 3 = 472
I_x = 1,480
10 x 7 x $\frac{2}{3}$ x 6 = 280
6 x 6 x $\frac{2}{3}$ x 4 = 96
I_y = 376
I_p = 1,480 + 376 = 1,856

Calculation of the polar moment of inertia of rivet groups is simplified by a procedure involving the numbering of the rivets in a row and adding.

Field and Office Comment

Vertical Curve Corrections

Sir: For the benefit of Samuel Lechner (*ENR* Aug. 8, vol. p. 187), Robert T. Ewen (*ENR*, Dec. 12, vol. p. 810) and perhaps others, in figuring vertical curve corrections in the future, the following method is most simple and uses only the basic information which the designer begins with, namely: the algebraic difference in grades and the length of curve:

1. Set algebraic difference on "A" scale.
2. Under this on "B" scale set twice the length of curve.
3. Read corrections on "A" scale opposite the distances on "C" scale from either end of curve.

The middle ordinate will be found automatically at the half-length of curve reading.—H. B. Austin, *Austin Engineering Co., Peoria, Ill.*

Book Notes and Reviews

The month's addition to the engineer's reading and reference list

For Specification Writers

The National Electrical Code—Vol. V of National Fire Codes. 376 pp. National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass. $2.

Specification writers seeking the most up-to-date information on safety requirements for the installation of electrical wiring, outlets etc., will find it in the book, which for the first time gives the electrical code requirements of the National Fire Protection Association in a convenient desk reference size, uniform with the other codes of the association. This edition supersedes the 1940 edition and interim amendments. It has been approved by the American Standards Association.

English in Engineering

Personality and English in Technical Personnel—By Philip McDonald. 425 pp. D. Van Nostrand Co., New York. $3.75.

Encouraging ideas and suggestions about expanding one's vocabulary, learning to use better English and developing more skill and facility in speaking and writing are to be found in this book. Examples and citations are given in abundance and young engineers particularly will find value in the chapters on mastery of words, sentence structure, writing letters and writing reports.

In discussions about methods of writing and speaking the author goes into much detail. He gives many examples of the common extremes in saying too much or too little and uses these to emphasize the desirable middle course.

The book could be collateral reading in a postgraduate or refresher course because it takes up such topics as how criticism benefits a young technician, how personalities are judged by the written and spoken word, how to write a technical article, avoiding common mistakes in English and language as a test of personality.

At least this is the trend and tenor of the first 24 chapters. That far the main theme follows the course indicated by title and foreword. Then the author yields to what appears to be an interest in certain favorite topics or perhaps to a desire to make this one book an all-comprehensive coverage of subjects whose relation to the main theme is not very clear. This digression, plus the author's tendency to use many examples and frequent quotations, make the book rather lengthy for a work of this sort.

Beginning with the 25th chapter the next half dozen or more refer largely to biography and history. More than 100 pages are devoted to the logic and writings of the ancient Greeks and Romans. Then, at the end of the volume, the reader is brought back to modern times by a running fire of commentary, sometimes frankly critical of American engineers, centering around noted engineering failures, including the Quebec Bridge and the St. Francis Dam.

Railway Maintenance

Roadway and Track—Third Edition. By Walter F. Rench. 350 pp. Simmons-Boardman Publishing Co., New York. $5.

General work for the maintenance of railway track is covered effectively in this book, which assumes that the reader is familiar with the track structure and the organization of section forces and extra gangs. The material and methods described relate mainly to the regular practice of the Pennsylvania R. R., supplemented by recommendations of the American Railway Engineering Association. More standardizing of track material and methods is considered desirable by the author.

While the various routine or ordinary operations and methods are dealt with, the book lacks information for the engineer, roadmaster (or supervisor) and foreman as to special features involved in modern railway work, such as: (1) practical and economic aspects of the use of machines (on-track and off-track) in relation to modern traffic and labor conditions; (2) the close relation of maintenance operations to traffic, and the objectionable "slow orders" interfering with train movements; (3) the meticulous finish or sand-papering of line and surface that is required for track carrying high-speed trains for both safety and easy riding.

Machines and mechanical appliances and tools described include those for stabilizing both roadbed and ballast by grouting, as well as those for tamping ballast, handling rails and performing other work. An interesting section relates to determining the causes of train accidents.

New Engineering Books

Roadway and Track—Third Edition. By Walter F. Rench. 350 pp. Simmons-Boardman Publishing Co., 30 Church St., New York, N. Y. $5.

Resistance of Materials—Third Edition. By Fred B. Seely. 486 pp. John Wiley & Sons, New York 16; Chapman & Hall, London. $4.

Elements of Soil Conservation—By Hugh H. Bennett. 406 pp. McGraw-Hill Book Co., New York 18, and London. $3.20.

Mechanics of Materials—Second Edition. By P. G. Laurson and W. J. Cox. 422 pp. John Wiley & Sons, New York 16; Chapman & Hall, London. $4.

Surveying Theory and Practice—By J. C. Tracy, 1927 pp. John Wiley & Sons, New York 16; Chapman & Hall, London. $7.50.

Proceedings of the Society for Experimental Stress Analysis—By C. Lipson & W. M. Murray. 129 pp. Addison-Wesley Press, Inc., Kendall Sq. Building, Cambridge 42, Mass.

Calculo De Estructures Reticulares—Fourth Edition. By Carlos Fernandez Casado. 457 pp. Published by Dossat S. A., Madrid, Spain. Price 84 ptas. Obtainable through Stechert, Hafner Inc., 31 East 10th St., New York 3, N. Y.

Portland Cement Technology—By J. C. Witt. 518 pp. Chemical Publishing Co., Brooklyn, N. Y. $10.

Contributions to Soil Mechanics—1925-1940. 413 pp. A reprint of papers before the Boston Society of Civil Engineers and the New England Water Works Association. Published by the Boston Society of Civil Engineers, 715 Tremont Temple, Boston 5, Mass. $2.25.

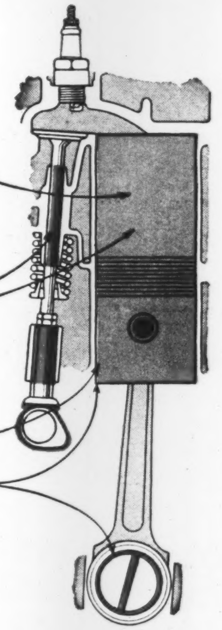
Science and Freedom—By Lyman Bryson. 191 pp. Columbia University Press, 2960 Broadway, New York. $2.75.

Panel Heating and Cooling Analysis—By B. F. Raber and F. W. Hutchinson. 208 pp. John Wiley & Sons, New York 16, N. Y. $3.50.

DDT and the Insect Problem—By James C. Leary, W. I. Fishbein and L. C. Salter. 176 pp. McGraw-Hill Book Co., New York 18, and London. $2.50.

(*Continued on p.* 138)

STANDARD ENGINEERS NOTEBOOK

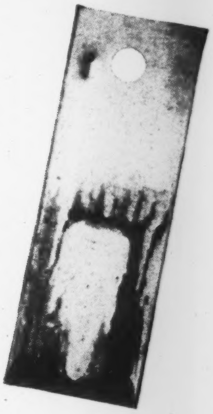


① Adhering agent in RPM Compounded Motor Oil keeps oil film on all parts after engine stops, even on cylinder walls.

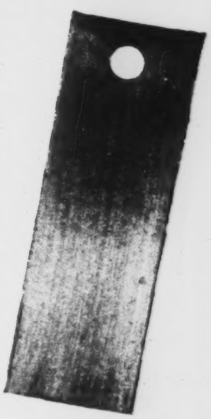
② Rustproofing compounds prevent moisture that condenses on cooling parts from contacting metal.

③ No rust is formed to scrape off when engine starts, and cause excessive wear.

④ Constant lubricant film provides adequate and instant lubrication when engine starts.



This actual photograph shows how one HIGH-QUALITY MOTOR OIL "peeled" off almost all of this test strip of steel when it was placed in corrosive-moisture conditions similar to those in a cooling engine. The oil concentrated at one spot and the unprotected surface quickly rusted.



RPM COMPOUNDED MOTOR OIL kept this strip bright and shiny, completely sealed against rusting, when it was exposed to the same conditions. "RPM" compounds keep a constant rust-proofing lubricant film on engine parts at all times, whether they are idle or moving.

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Other compounds in RPM Motor Oil give it adherent qualities so the film stays on parts at all times. They also loosen and remove gum and lacquer, lubricate hot spots, resist sludge formation, bearing corrosion and stop foaming.

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FOR EVERY NEED A STANDARD OF CALIFORNIA JOB-PROVED PRODUCT

March, 1947

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

CAST IRON PIPE price increases, ranging from $.10 to $1.35 per net ton, occurred in all the 20 cities this month, with the exception of Birmingham and Montreal. The greatest rises were evident in Chicago, Cleveland, Dallas, Detroit, Kansas City, and Minneapolis. A similar trend materialized in the prices of WHITE LEAD. Prices rose $.75 per 100 lb. in all the cities except Dallas, where no price change was reported. READY MIXED CONCRETE rose $.25 to $.67 per cu. yd. and VITRIFIED SEWER PIPE $.01 to $.30 per foot.

Steel prices continued to show substantial gains this month, although the increases were not as widespread as a month ago. Warehouse STRUCTURAL STEEL prices rose $.25 to $.53 per 100 lb.; REINFORCING BARS rose $.05 to $.70 per 100 lb.; and EXPANDED METAL LATH rose $.50 to $2.50 per 100 sq. yd. PORTLAND CEMENT prices showed gains ranging from $.02 per bbl. to $.70. Current maximum base mill prices of cement rose $.15 per bbl. in Ironton, Ohio; Northampton, Pa.; and Universal, Pa., and $.10 per bbl. in Montreal.

CEMENT, AGGREGATE, READY-MIXED CONCRETE—F. O. B. CITY

	PORTLAND CEMENT Per bbl. C/L lots incl. 40c per bbl. for bags, cash dis. not deducted			SAND AND GRAVEL Per ton, carload lots			CRUSHED STONE Per ton, carload lots		CRUSHED SLAG Per ton, carload lots, f.o.b. plant		CONCRETE BLOCK 8x8x16-in.; truckload del.; per block		CONCRETE Ready Mixed 1:2:4. over 50 c.y. del.
	Cloth	Paper	Bulk	Gravel. 1½ in.	Gravel. ¾ in.	Sand	1½ in	¾ in.	1½ in	¾ in.	Sand grav.	Lt.wgt.Agg.	
Atlanta	$2.77	$2.52	$2.43	$1.79	$1.89	$1.65	$1.79	$1.89	$1.59	$1.69	$0.17	....	$9.00
Baltimore	2.99*a*	2.74*a*	2.49*a*	2.10‡	2.10‡	1.60‡	2.00‡	2.00‡	2.00‡	2.00‡	.145	$0.145*w*	8.00
Birmingham	3.65	2.80	....	2.06	2.06	1.63	2.50	2.50	1.00	1.20	.1425	.1425	6.90
Boston	3.70*bgg*	2.85*b*	2.60	1.50‡	1.50‡	1.40‡	1.25	1.35	....	....	.13	.155*w*	7.90*m*
Chicago	3.75*gg*	2.90	2.75	2.50‡*d*	2.50‡*d*	2.75‡*d*	2.50‡*d*	2.50‡*d*	2.00‡	2.00‡	.195	.195*x*	....
Cincinnati	....	....	....	....	....	....	....	....	....	....	...	....	....
Cleveland	3.47*gg*	2.47	2.22	2.50‡	2.50‡	2.55‡	3.30‡	3.20‡	....	....	...	19	9.65
Dallas	3.31	2.46	2.21	1.80	1.80	1.60	1.89	1.99	....	....	.0775*p*	....	8.68
Denver	3.83	2.98	2.73	1.85	2.00	1.15	....	....	....	....	....	.2175*w*	9.00
Detroit	3.28*gg*	2.43	2.23	2.75	2.75	2.50	2.50	2.50	2.25‡	2.25‡	.16	.17*w*	8.30*kk*
Kansas City	3.00	3.00	....	2.00	....	1.40	2.00	2.00	....	....	.16	.16*wy*	8.75*n*
Los Angeles	3.60*r*	2.90*r*	....	1.55	1.55	1.40	1.40*f*	1.40*f*	1.40*f*	1.40*f*	.125*bb*	.14*bb*	8.75*m*
Minneapolis	4.25*dd*‡*gg*	3.40*dd*‡	....	1.90*h*‡	1.90*h*‡	1.00*h*‡	1.90*h*‡	1.90*h*‡	....	....	.183*ff*	....	9.40*jkk*
Montreal	....	2.05*r*	1.90*r*	1.65‡*s*	1.65‡*s*	1.10*t*	.95*ct*	1.05*ct*	....	....	.1391	.1515	7.75*ls*
New Orleans	3.18	2.43	2.18	1.82	1.82	1.62	....	....	.90	1.15	.23	....	9.92
New York	4.31‡*gg*	3.31‡	....	1.80*deu*	1.80*deu*	1.15*eee*	1.90*de*	1.90*de*	....	....	.17*ii*	.18*wccii*	8.95*k*
Philadelphia	3.30	3.20‡	2.32‡	1.55‡	1.65‡	1.20‡	1.90‡	1.95‡	1.25	1.25	.155	.155*w*	8.80
Pittsburgh	2.80	2.55	2.35	1.85‡	1.85‡	2.15‡	2.35‡	2.35‡	1.80	1.80	.21*z*	.21*z*	9.85
St. Louis	3.96*ogg*	3.08*o*	....	2.10‡*o*	2.10‡*o*	2.10‡*o*	1.25/1.95	1.25/1.95	....	....	.175	.22*yo*	9.45
San Francisco	3.54*jj*	2.64	2.24	1.56	1.56	1.66	1.66	....	....	....	....	.25*y*	9.60
Seattle	....	2.99*o*	....	2.35*d*‡	2.35*d*‡	2.35*d*‡	2.85‡*od*	2.85‡*od*	....	....	.17	....	8.25

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash *c* F.o.b. quarry. *d*. Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* F.o.d. Granite City, Ill. *h* Truck Lots. *i* Within three miles of Public Square. *j* 5% discount for cash *k* Discount of 2 percent for cash in 10 days. *l* 2000 lb. concrete. *m* 50c. off for cash. *n* 25 c.y. or more *o* 2% off for cash. *p* 5½ x 8 x 12 in. *q* 5 cu. yds. or more. *r* 10c. per bbl. off cash 20 days. *s* 8% sales tax included. *t* 8% sales tax not included. *u* In outlying New York districts, price is $1.89. *v* 20c. per bbl. discount; 80c. per bbl. for bags. *w* Cinder *x* Waylite. *y* Haydite. *z* Celocrete. *aa* Pumice. *bb* 4 x 8 x 12 in. *cc* Also 8 x 18 in. *dd* Prices quoted are LCL. Carload lots not available. *ee* In outlying New York districts, price is $1.22. *ff* 8 x 8 x 18 in. *gg* $ .25 refund for each returnable bag. *ii* Yard price. *kk* 2500 lb. compression strength. *jj* $ .30 refund for each returnable bag.

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount. 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c. per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICE BASES AT CEMENT MILL

Charge for bags not included. For cloth bags, add $1.05c. per bbl.; 25c. refund allowed for each returnable bag; for paper bags add 20c. per bbl., not refundable.

	Bagged	Bulk
Buffington, Ind.	$1.90	$1.85
Hannibal, Mo.	1.90	1.85
Independence, Kans.	1.90	1.85
Ironton, Ohio	$1.95*	$1.90*
Northampton, Pa	1.90	1.85
Richard City, Tenn	2.05*a*	1.95
Steelton, Minn.	2.00	1.95
Universal, Pa.	$2.00	$1.95
Waco, Tex. (Plus 9c. tax in Tex.).	1.75	1.70
Montreal City (Discount 10c. per bbl. 20 days)	1.78	1.78

* Destination price base effective Sept. 17. 1945

a For cloth bags, add $1.00.

PAVING BRICK, BLOCK, ASPHALT, ROAD OILS—F. O. B. CITY

	PAVING BRICK AND BLOCK			PAVING ASPHALT Per ton, less than 80 penetration		ASPHALT BINDERS—FLUXES Per gal., 80–300 penetration		CUTBACK ASPHALT Per ton		ROAD OIL Per gal	ASPHALT EMULSION (Quick-breaking) Per gal	
	Granite per M lots of 50,000 4x4x8 in.	Brick per M 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$73.00	$35.00	$2.25	$14.00	.....	$0.074	.....	$0.0806*h*	.....	$0.0781	$0.0806	.....
Baltimore	150.00‡	52.70	85.00*m*	15.00*r*	21.00*r*	.06*r*	0.09*r*	13.00*r*	23.00*r*	.06*r*	.07*r*	.14*r*
Birmingham	.....	32.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Boston	85.00	59.00	3.75	16.00	25.00	.0675	.12	18.00	31.00	.0675	.0875	.15
Chicago	150.00‡	65.00/68.00*e*‡	2.97/4.10*d*‡	16.50*b*	24.00*b*	15.50*bg*	23.00*bg*	.07/.0725*bh*	.16/.1625*bh*	.0525/.0575*b*	.0925/.1025*b*	.135/.165*b*
Cincinnati	......	.....	.....	.....	.....	...	.....	....	.....	...	.....	.....
Cleveland	150.00	49.00*t*	3.43*v*	18.00	26.00	17.00*g*	25.00*g*	.08*h*	.16*h*	.075	.10	.18
Dallas	.....	40.00	.....	16.95	29.15	.0686	.1225	20.00	37.60	.06	.0725	.135
Denver	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	75.00*t*	.....	17.60*f*	26.56*f*	.0734	.128	.0718*h*	.119*h*	.067	.0974	.135
Kansas City	.....	40.00	.....	15.00*u*	20.60*u*	16.60*g*	.....	.07*h*	.0765*hu*	.....	.11	.15*u*
Los Angeles	.....	60.00	.....	9.00*b*	23.00*b*	9.50*bg*	24.00*bg*	9.50*bg*	.....	.03*b*	.08*b*	.16*b*
Minneapolis	.....	.....	2.39*d*	.....	.....	.....	.....	.....	.....	....	.....	.....
Montreal	100.00	.....	.....	16.60*k*	24.25*k*	.1160*k*	.1485*k*	.115*hk*	.135*hk*	.08*k*	.135*k*	.188*k*
New Orleans	.....	.....	.....	13.00*a*	.....*s*	12.50*g*	.....*s*	6.50	.....*s*	.055	.08	.13
New York	.....	.....	2.75*n*	20.68	32.85*s*	19.68*g*	38.68*g*	.0857*h*	.1669*h*	.0807	.0855	.1643
Philadelphia	150.00	62.00	4.06	19.00	.....	17.00	.....	.08*h*	.....	.....	14.00*gr*	.....
Pittsburgh	135.00	39.75	3.90	19.00	27.00	.095	.185	22.00	34.00	.075	.085	.15
St. Louis	.....	42.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Francisco	.....	47.75*c*	.....	11.75	25.25*w*	11.75*g*	.....	13.75	.....	.....	.0525	.1125*i*
Seattle	.....	.....	.....	11.75*i*	22.75*i*	9.50	.....	11.75*i*	14.75	10.90*i*	.0525*i*	.0625

‡ Delivered *a* F.o.b. Baton Rouge. *b* F.o.b. Refinery. *c* 2¾ x 8½ x 4 in. *d* 2-in. interior block, 6-lb treatment. *e* 3½ x 4 x 8½ *f* Mexican. *g* Per ton. *h* Per gallon *i* F.o.b. Martinez. *j* 3 x 3½ x 8½ in *k* Tax included. *l* Quoted on request only *m* Per thousand *n* 2 in., treatment 6 lb. *r* February 1943 prices, none later available *s* Drums not available. *t* Truck deliveries in Greater Cleveland. *w* Shipped in double head wood barrels. *v* 3 in. block

A development of
B.F. Goodrich
FIRST IN RUBBER

Tread digs in but tire doesn't; it's built to float—has greater bruise resistance

IN EXCAVATING and dumping operations, two major tire problems used to make tire costs unnecessarily high. Miring, wheels bogging down in sand, loam, and loose dirt, cost the time of the truck, men, and oftentimes other machines. The second problem was rocky ground or terrain which meant tire impacts on boulders, ruts, timbers, etc., leading to bruises, ply separation, and blow-outs.

The answers to these problems are found in tires such as those shown above — Super Traction Tire designed by B. F. Goodrich engineers. Bogging down was solved with a wider and flatter tread which has greater contact area to provide maximum flotation. The tire is built to float, yet the heavy tread digs in, *grips.*

Answer to problem number two was a special built-in *shock shield* for greater bruise resistance. This shield, an exclusive B. F. Goodrich feature, is a set of four breakers — layers of rubber-coated nylon cords — built in between the tread and the plies. The breakers are in pairs with the cords in each pair running in opposite directions to give balanced strength.

Under impact, the cords in the breakers stretch together, *not* across each other, and return to their original position. The blow is *distributed*, absorbed by the rubber cushions; shock passed on to the cord body is greatly reduced.

Users of the Super Traction and other B. F. Goodrich tires built this way report substantial savings in operating costs. Traction is better. Tire life is longer. Repair bills lower. Find out how these tires can help solve *your* problems. See the B. F. Goodrich dealer or write us direct. *The B. F. Goodrich Company, Akron, Ohio.*

Truck Tires BY
B. F. Goodrich

How to pick the RIGHT SCRAPER to make the MOST PROFIT!

IN times like these it's doubly important to consider every piece of equipment strictly on *its own merits.* This is especially true of tractor-drawn scrapers because regardless of what make of crawler tractors you use, it's the scraper that handles the "payload," which in turn controls your profit on every job. To make the most profit then, it naturally pays to pick the scraper that will move the most yardage at the lowest cost under the widest range of job conditions.

While you hear a lot of "claims" about scraper performance, the fact remains that on hundreds of the world's toughest earthmoving jobs *LaPlant-Choate Positive Forced Ejection Scrapers are out-performing competitive rigs by a wide mar*
They're getting bigger "payloads" faster with
power . . . spreading them faster at the fill
and saving hours of costly "down time"
maintenance and repairs. Moreover, LaPl
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of materials including hard-to-load sand, ro
sticky gumbo, and whatnot. So why take a cha
with inferior, unproved scrapers when you
make more money under more conditions w
job-proved LaPlant-Choate rigs. Get the f
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***Positive* FORCED EJECTION SCRAPERS**

FIRST in Value because th
FIRST in Performa

March, 1947

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS billet *be*	RIVETS ½-in. structural	WIRE NAILS Based	SHEET PILING Base	STEEL RAILS Per Net Ton Standard	Light	Re-rolled	TRACK SUPPLIES Angle Bars	Std Spikes *c*	Tie Plates *c*	Track Bolts
Birmingham	$2.50	$2.45	$5.25	$3.75/4.50	....	$50.00	$57.00	Not	$3.00	$3.65/4.50	$2.80	$6.50
Chicago	2.50	2.45	5.25	3.75/4.50	$3.00	50.00	57.00	avail-	3.00	3.65/4.50	2.80	6.50
Pittsburgh	2.50	2.45	5.25	3.75/4.50	3.00	50.00	57.00	able	3.00	3.65/4.50	2.80	6.50
Buffalo	2.50	2.45	....	....	3.00	.....	.....	.....	....	....	2.80	....
Cleveland	....	2.45	5.25	3.75/4.50	....	.....	.....	.....	....	....	....	....
Youngstown	....	2.45	....	....	....	.....	.....	.....	....	3.65/4.50	....	....
Detroit	....	2.585‡	....	....	....	.....	.....	.....	....	....	....	....
Gulf ports	2.735*a*	2.835*a*	....	....	....	.....	.....	.....	....	....	....	....
Geneva	2.65	.....	....	....	....	.....	.....	.....	....	....	....	....
Los Angeles	....	3.025‡	....	....	....	.....	.....	.....	....	....	....	....

‡ Delivered *a* F.o.b. cars dock. *b* Rail steel same as billet prices *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone. Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va *d* Add switching charge $18 per cl *e* Mill lengths. Add $ .50 for cut lengths.

IRON AND STEEL PRODUCTS—F. O. B. WAREHOUSE, PER 100 LBS., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb base price	REINFORCING BARS*g* Per 100 lb., base price*u* 5 tons to carload lot *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH Per 100 sq. yd., carload lots Std diamond mesh, 3.4 lb	Std. ribbed 3.4 lb	WELDED FABRIC REINFORCING Per 100 sq. ft., carload lots 4x16 in., No 5 & 10 wires	4x12 in., No 8 & 12 wires	6x6 in No 6 & 6 wires Per 100 s. f	SHEET PILING Per 100 lb base price
Atlanta	$4.05‡	$4.12‡	$4.12‡	$.025	$.10	$23.16	$25.30	$2.00	$1.50	$2.12	$3.35
Baltimore	3.909	3.344	....	....	.10	24.50	26.50	1.88	1.42	2.00	3.25
Birmingham	2.50*a*	2.45*a*	2.45*a*	.05	.10	36.00*p*	39.00*p*	1.98	1.49	2.10	....
Boston	4.162‡	4.194‡	2.97*c*	$20 C.L.	.10	18.50	20.50	1.94	1.46	2.05	3.02
Chicago	2.50*a*	2.45*a*	2.60/2.95*a*	.05	.05	24.00‡	26.00	1.85	1.40	1.96	3.00
Cincinnati	....	....	....	....	....	.....	.....	1.87	1.41	1.96	....
Cleveland	4.311	3.40	....	.025	.10	26.00	28.00	1.84	1.40	1.95	....
Dallas	6.00	5.00	5.00	....	....	31.00	35.00	2.11	1.57	2.22	....
Denver	5.50	4.77*c*	....	....	....	38.50	41.00*q*	2.15	1.60	2.28	....
Detroit	4.42‡	3.591‡	3.591‡	....	.10	38.00‡	42.00‡	1.86	1.41	1.97	3.31
Kansas City	4.85	2.95*cd*	2.80*cd*	.0	.05	30.00	32.00	1.96	1.48	2.08	3.0826
Los Angeles	5.20*f*	3.025	2.875	.03	.05	23.00	27.50	2.11	1.57	2.24	5.20
Minneapolis	4.392‡	3.69	3.69	.0	.10	26.50	28.50	1.98	1.49	2.10	3.47*d*
Montreal	4.55*i*	4.20*i*	4.20*i*	.....	....	36.00*hi*	38.70*hi*	2.87	3.54*i*	2.96*im*	73.00*j*
New Orleans	4.408‡	4.03*o*	4.108	.05	.10	27.50	29.50	2.00	1.50	2.12	3.125
New York	4.17*r*	3.85	....	....	.10/.15	30.50*st*	32.505*st*	1.90	1.44	2.02	2.74
Philadelphia	3.97	4.24	....	.....	....	22.50‡	24.75‡	1.89	1.43	2.00	3.41
Pittsburgh	4.05‡	3.20	3.20	.05	.10	23.00	26.80	1.77	1.35	1.88	3.00
St Louis	3.93	3.49	3.49	.0	.05	34.00	36.00	1.87	1.42	1.97	....
San Francisco	4.90	3.06	2.875	.025	.10	28.00	31.50	2.11	1.57	2.24	4.50
Seattle	3.00*e*	3.00*e*	....	....	....	43.50	44.00	2.11	1.57	2.24	3.20*e*

‡ Delivered. *a* Mill prices. *b* 1–5 tons, add 35c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus freight. *e* F.o.b dock. *f* Includes delivery in free delivery zone *g* High scrap steel prices cut former 15c. differences between new billet and rail steel in many mills. *h* List price. *i* Plus Dominion and Province sales tax. *j* Price per ton. *m* Per sq. yd. *n* Practically no carloads are available. Retail price delivered is $27.00 for std. diamond mesh and $29.00 for std. ribbed. *o* 5 to 15 tons Base. *p* Deliveries of 5000 sq. yd. or less. *q* ⅜ in. standard ribbed. *r* 5 tons or over. *s* LCL. *t* Asphalt coated. *u* Note: Revised size extras—¾ in and over $ .15, ⅝ in $ .20, ½ in $ .30, ⅜ in. $ .50, ¼ in. $1.20.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in. *a*	VITRIFIED SEWER PIPE Per foot, Delivered std. 8 in. s.s.	std. 12 in s.s.	24 in.	36 in.	CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b. 6 in	8 in.	CONCRETE SEWER PIPE Per ft., delivered: ASTM 12 in	C 14–35 24 in	WROUGHT STEEL PIPE (Full standard weight, f.o.b. destination *s*) 1 to 3 in., Butt Weld Black %	Galv %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta	$70.28	$0.43	$0.67	$3.39	....	$114.00	$140.00	$0.45	$2.00	53.2	40.2	50.7	37.2
Baltimore	74.60	.35	.60	2.70	$7.25	160.00	200.00	.85	2.25	56.9	43.9	54.4	40.9
Birmingham	65.00	.375	.675	3.06	....	210.00	350.00	.57/1.00	1.85/2.50	53.2	40.2	50.7	37.2
Boston	77.20	.392*m*	.756*m*	3.15*m*	7.995*m*	170.00‡*m*	265.00‡*m*	.53	2.04	55.2	42.2	52.7	39.2
Chicago	75.56	.49	.95	3.60	....	200.00‡	270.00‡	.65	2.25	59.0*t*	46.0*t*	55.5*t*	42.0*t*
Cincinnati	74.36	....	....	...	....	......	......	.54	2.00	57.4	44.4	54.9	41.4
Cleveland	76.04	.294	.567	2.565	6.8675	112.00*p*	176.00*p*	.58	2.25	59.65	46.65	57.15	43.65
Dallas	77.78	.375	.675	2.70	6.20	109.00	131.00	.45	1.45	51.3	38.3	48.8	35.3
Denver	82.62	.38	.68	2.84	....	......	......	....	....	49.4	36.4	46.7	33.2
Detroit	76.04	.455	8.775	3.375	8.50*l*	170.00‡*m*	263.00‡	.40	1.45	57.9	44.9	55.4	41.9
Kansas City	77.12	.345	.625	2.48	7.00	175.00	312.00*m*	.50	1.70	54.7	41.7	51.8	38.3
Los Angeles	89.00	.414†	.745†	2.988	7.47	157.00	260.00	1.25	2.50	....	....	....	....
Minneapolis	79.10	.51†*o*	.98†*o*	3.95†*o*	....	......	......	.95	2.43	54.8	41.8	51.9	38.4
Montreal	78.20	.68	1.20	3.94	6.38*e*	.48*p*	.68*p*	72.00*jk*	218.00*jk*	....	....	....	....
New Orleans	72.68	.40	.72	3.558	....	112.00	......	.55	1.95	52.4	39.4	50.3	36.8
New York	73.80	.52	1.01	4.00	9.43	......	......	.75	1.85	56.2	43.2	53.7	40.2
Philadelphia	72.20	.50	.95	3.95	9.75	220.00	275.00	.90	2.75	56.7	43.7	54.2	40.7
Pittsburgh	76.52	.322†*m*	.631†*m*	2.70†*m*	6.625*m*	124.20	193.90	1.05	2.50*g*	60.0*t*	47.0*t*	57.5*t*	44.0*t*
St Louis	73.88	.351*n*	.632*n*	2.527*n*	5.60*n*	105.80	212.00	1.20*h*	2.55*i*	56.6	43.6	53.2	39.7
San Francisco	89.00	.4375*d*	.7875*d*	3.15	7.875	159.00	265.00	.65	2.70	....	....	....	....
Seattle	90.80	.4375*b*	.7875*b*	3.15	....	......	......	.56*f*	1.60*f*	....	....	....	....

‡ Delivered. † F.o.b. *a* B. & S class B and heavier, C/L lots, Burlington, N. J. (base) $70.00. Based on existing freight rates; subject to rate change. Gas pipe and class A, $5 per ton additional. 4 in., $5 per ton additional, 30 in. and larger, usually $1 per ton less. *b* Double strength. *d* List. *e* 30 in. *f* Less 5% for cash. *g* Culvert pipe *h* Reinforced; spec. C–76–37. *i* Reinforce, spec. C–75–41. *j* Centri-spun. *k* Per 100 feet. *m* Truck delivery. *n* Less 3% for cash. *o* Since carload lots are not available at this time, listed price is based on LCL (no minimum). *p* Less than 5 ton loads, price per foot. 5% discount 10th of month following.

s Discounts from standard list consumers carload prices. Base price approx $200 per net ton. List prices per ft.: ½ in., 8½c.; ¾ in., 11½c.; 1 in., 17c.; 2 in. 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92; 3 percent tax on transportation costs not included. *t* Within switching limits. WROUGHT IRON PIPE: List prices per ft. same as wrought steel pipe. Discount for Pittsburgh base. Buttweld — 1 in. and 1¼ in. black, 34, galv., 16; 1½ in. black, 38, galv., 18½; 2 in. black, 37½, galv., 18. Lapweld — 2½ in. to 3½ in. black, 31½, galv., 14½; 4½ in. to 8 in. black, 32½, galv., 17. Freight rates to destination to be added to name delivered price.

FACTS YOU SHOULD KNOW BEFORE YOU BUY *Any* TRUCK WINCH

BRADEN LEADS IN *Economy of Operation*

Weight has much to do with the economical operation of any winch truck. That's why Braden specifies materials that are light in weight yet have the strength and durability necessary for top performance. Compare the weight of any Braden model with that of any other winch of comparable rated capacity.

BRADEN LEADS IN *Safety of Operation*

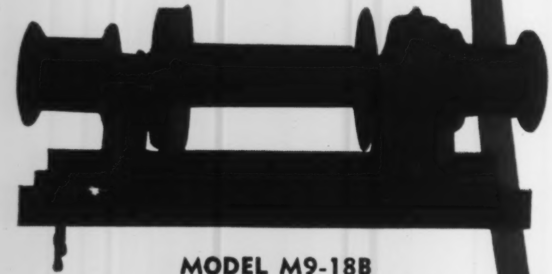
Only Braden winches have the new OIL COOLED, FULLY ADJUSTABLE, AUTOMATIC SAFETY BRAKE that brings new safety features to winches never before attained. Oil Cooling minimizes brake lining burnout. A slight turn of a wrench adjusts the brake. The BRADEN OIL COOLED brake has such a wide range of automatic action that adjustments are required only in one to three years.

BRADEN LEADS IN *Dependability*

Timken Tapered Roller Bearings protect vital parts of every Braden Winch where excessive radial and thrust loads occur. This means less wear, dependable service and long life. All moving parts are precision made and thoroughly tested for effective operation.

BRADEN LEADS IN *Performance*

The features above, as any winch operator knows, prove that Braden winches lead in ease of operation, long life, lower maintenance cost and greater safety. Specify BRADEN WINCHES for any handling job. They are SAFER, BETTER winches.



MODEL M9-18B

Has Safe Working Load of 18,000 lbs. The NEWEST of the Braden "M" Series. For use on 1½ to 2½ ton trucks. Equipped with the NEW OIL COOLED, FULLY ADJUSTABLE, AUTOMATIC SAFETY BRAKE.

Write for Complete Catalog

"BUY BRADEN — THEY ARE SAFER"

BRADEN WINCH COMPANY

1001 East Admiral Boulevard

BRADEN

TULSA 3, Oklahoma

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR All S. L. Y. P. is No. 2 common or better and for No. 1 N C. Box. (Prices in Bold Face) *All Fir planks No. 2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)*									LONG LEAF Y. P Merchantable grade up to 20 ft.		PLYWOOD Rail freight increment (See note for base price)	
	1x6 s4s	1x8 s4s	2x4 s4s	2x6 s4s	2x8 s4s	2x10 s4s	3x12 Rgh	6x12 Rgh	12x12 Rgh	2x12 Rgh	12x12 Rgh	⅝"	¾"
Atlanta	$75.00	$75.00	$65.00	$65.00	$65.00	$65.00	.....	.....	.....	$86.00	$86.00	$17.72	$21.87
	90.00	*90.00*	*88.50*	*88.50*	*87.50*	*87.50*	*$81.00*	*$80.50*	*$79.50*	.....	.....	......	......
Baltimore	74.00	75.00	71.00	70.00	70.00	77.00	90.00	.....	.....	185.00	180.00	18.45	21.995
	80.00	*82.00*	*80.00*	*74.00*	*79.00*	*80.00*	*95.00*	*87.00*	*85.00*	.....	.....	......	......
Birmingham	87.50	87.50	87.00	86.00	87.00	90.00	110.00	.....	.....	110.00	112.50	17.245	20.795
[1]	*92.50*	*92.50*	*92.00*	*91.00*	*92.00*	*95.00*	*114.00*	*97.00*	*98.00*	.....	.....	......	......
Boston	70.00[3]	72.00[3]	66.50[3]	62.50[3]	70.50[3]	74.50[3]	70.25[3]	.....	.....	.....	.....	18.195	21.995
	64.75	*64.75*	*62.75*	*63.25*	*62.75*	*62.75*	*60.50*	*59.50*	*59.50*	*59.50*	.....	......	......
Chicago ‡	100.00	100.00	95.00	95.00	95.00	98.00	98.00	.....	.....	125.00	125.00	14.555	17.555
‡	*100.00*	*100.00*	*95.00*	*95.00*	*95.00*	*98.00*	*95.00*	*95.00*	*95.00*	....	....	......	......
Cincinnati	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17.245	20.795
Cleveland k	120.00	120.00	120.00	120.00	120.00	125.00	130.00	.....	.....	140.00	150.00	17.615	21.265
k	*125.00*	*125.00*	*125.00*	*125.00*	*125.00*	*130.00*	*135.00*	*135.00*	*140.00*	.....	.....	......	......
Dallas	59.00	59 00	56.75	57.75	59.00	61.50	61.00	.....	.....	94.75	91.00	14.555	17.555
Denver	*91.50*	*91.50*	*94.50*	*94.50*	*93.50*	*94.50*	.....	.....	.....	.....	.....	10.285	12.435
Detroit	90.00	90.00	87.00	87.00	87.00	93.00	100.00	.....	.....	95.00	110.00	17.245	20.795
	98.00	*98.00*	*96.00*	*97.00*	*97.00*	*100.00*	*105.00*	*105 00*	*110.00*	.....	.....	......	......
Kansas City a	86.00	86.00	84.00	82.75	83.25	86.00	105.00	.....	.....	105.00	110.00	12.605	15.205
	88.00	*88.00*	*87.50*	*87.50*	*85.50*	*87.00*	*85.00*	*105.00*	*105.00*	.....	.....	......	......
Los Angeles a	*87.00*	*87.00*	*88.00*	*89.00*	*87.00*	*87.00*	*100.00*	*100.00*	*89.00*	.....	.....	9.81gh	11.86gh
Minneapolis ‡b	99.00[6]	97.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.765	16.615
‡	*100.00*	*100.00*	*94.75*	*95.00*	*93.75*	*95.25*	*118.00*	*117.00*	*116.00*	.....	.....	......	......
Montreal e[7]	69.00	70.00	64.00	68.00	70.00	75.00	.20i	.....	.....	.20i	.20i	......	......
	97.00	*97.00*	*97.00*	*97.00*	*97.00*	*97.00*	*87.00*	*87.00*	*87.00*	.....	.....	......	......
New Orleans	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14.555	17.555
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	......	......
New York ‡	97.50	97.50	97.50	97.50	97.50	97.50	$115.00	.....	.....	.....	.....	18.195	21.995
‡	.....	.....	*97.50*	*97.50*	*97.50*	*97.50*	*Range from $110 to $125*			.....	.....	......	......
Philadelphia	110.00	110.00	110.00	110.00	110.00	110.00	110.00	.....	.....	150.00	150.00	18.195	21.995
	120.00	*120.00*	*120.00*	*120.00*	*120 00*	*120.00*	*120.00*	*120.00*	*120.00*	.....	.....	......	......
Pittsburgh	59.40	61.80	71.35	63.60	69.45	73.10	84.85	.....	.....	130.60	141.00	17.88	21.63
	77.60	*76.70*	*74.70*	*73.90*	*73.80*	*74.35*	*91.35*	*96.85*	*96.85*	.....	.....	......	......
St. Louis j	112.00	112.00	110.00	108.00	108.00	115.00	115.00	*115.00*	*115.00*	115.00	115.00	14.555	17.555
San Francisco d	*91.00*	*91.00*	*87.25*	*87.25*	*86.25*	*86.25*	*81.00*	*72.50*	*72.50*	.....	.....	7.33g	8.83g
Seattle	*70.00a*	*70.00a*	*70.00a*	*70.00a*	*70.00a*	*70.00a*	*70.00a*	*70.00a*	*70.00a*	.....	.....	......	......

Bold Face type. Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers' N. C. Pine. [3] Spruce. [4] Native. [6] Western Pine, No. 3 Common. [7] Spruce. [8] Norway Pine. ‡ Delivered. *a* Yard prices. *c* 5M ft. or less. *d* Sales through wholesale distribution yard (F.o.b purchaser's truck or carrier. San Francisco paid). *e* Plus sales tax. *f* Up to 18 ft. *g* Lower rate by water shipment. *h* 50,000 lb. minimum. *i* FBM, scarce, no stable quotation, no ceiling. *j* Delivered in 500 ft. lots. *k* These are retail yard prices. Lumber is no longer available on tne base previously quoted.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on ⅝", $95.15: on ¾", $104.85: price includes oiling and sealing charges. For other centers add rail freight increment from table or proper size. For resin dipped treatment, add $10 50 per M.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS Discounts from jobbers list, Jan. 16, 1946 Single or Double Thickness		EXPLOSIVES Per lb. 40% Ammonia Gelatin in 50 lb. cases delivered in 200 lb. lots*
	A quality	B quality	
Atlanta	76%	76%	$0.18
Baltimore	78%	79%	.18
Birmingham	76%	76%	.135
Boston	77%	78%	.18
Chicago	68%	68%	.18
Cincinnati	77–10%	77–10%	.18
Cleveland	67–10–10%	67–10–10%	.18
Dallas	76%	76%	.1925
Denver	68%	68%	.185
Detroit	77%	77%	.18
Kansas City	70.10%	70.10%	.18
Los Angeles	86%*d*	88%*d*	.1875
Minneapolis	68%	68%	.175
Montreal	40–5%*ab*	47%*ac*	.1975
New Orleans	70%	75%	.19
New York	73%	74%	.25*f*
Philadelphia	74%	75%	.18
Pittsburgh	77%	77%	.1525
St. Louis	77–10%	77–10%	.185
San Francisco	66%	73%	.185
Seattle	75%	75%	.1875

Price of 60% Ammonia Gelatin is $0.0125 per lb. higher than 40%

a Discount from list Sept 1939: sales tax included, but 6% tax exemption not allowed for. *b* Single thickness. *c* Double thickness. *d* Discount from jobbers' list Sept 15, 1928. *f* In borough of Kings, Queens and Richmond, and in Manhattan south of Canal St., add delivery charge of $6.00 per trip.

* Urban prices influenced by service charges or local storage and delivery regulations do not consistently reflect quantity prices in less congested areas.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me.	$0.15	$0.175	$0.195
W. of Miss. to Rocky Mtn. States. Fla. and Maine.	.155 –.1625	.18 –.1925	.20 –.2125
Rocky Mtn. States	.155 –.1675	.18 –.1975	.20 –.2175
Pacific N W States	.1525–.165	.1825–.195	.2025–.215
Pacific S. W. States	.15 –.1575	.18 –.1875	.20 – 2075

PILES, TIES F.O.B.

PILES

Prices per linear foot, fir and pine, bark on f.o.b cars New York. Fir based on Wash. and Ore. points to New York shipping area; pine based on freight from Norfolk.

			By Rail	
Dimensions	Points	Length	Pine	Fir
12 in. at butt	6 in.	30 to 50 ft.	$0.34	....
12-in.—2 ft. from butt	6-in.	50 to 59-ft.	.35	....
12-in.—2 ft from butt	6-in.	60 to 69-ft.	.36	....
12-in.—2 ft. from butt	6-in.	90 to 100-ft.	....	.57
13-in.—3-ft. from butt	5-in.	91 to 100-ft.	....	.59
14-in.—2-ft. from butt	6-in.	50 to 69-ft.	.41	.66
14-in.—2-ft from butt	6-in.	70 to 79-ft.	.43	.60
14-in.—2-ft. from butt	5-in.	80 to 85-ft.	.54	....
14-in.—2-ft. from butt	5-in.	85 to 89-ft.	.57	....
14-in.—2-ft from butt	5-in.	90 to 100-ft.	....	.65

* Pine piling over 80-ft. available only in limited quantities.

RAILWAY TIES

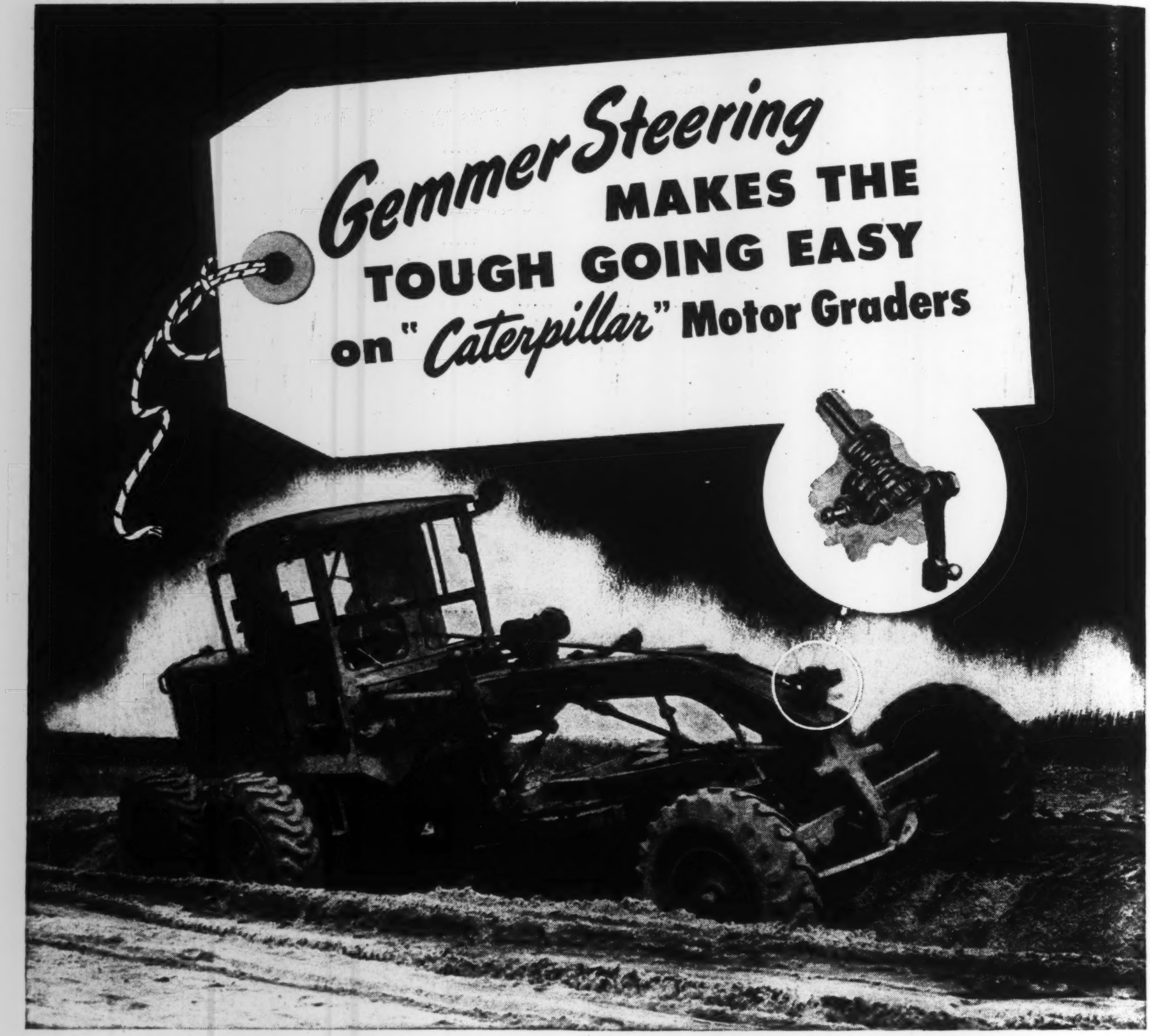
Prices f.o.b. per tie for carload lots:		6"x8"x8'		7"x9"x8'6"	
		Untr.	Tr.	Untr.	Tr.
Boston	Oak	$1.50	.....	$2.00	.....
	Pine	2.00	$3.00*a*	2.50	$3.00*a*
New York	S. L. Sap Pine	1.65	2.85	2.00	3.30
	Mixed Oak	1.80	3.05	2.50	3.60
Birmingham	Hardwood	1.00	1.60*a*	.....	2.25*a*
Chicago	Red Oak	.....	2.65/2.75*a*	.....	3.55/3.70
Los Angeles	Douglas Fir	2.10	3.35*a*	3.00	4.80*a*
Philadelphia	Red Oak	.....	2.10*ag*	.....	3.25*ag*
St. Louis	White Oak	1.80	.....	2.50	.....
	Red Oak	....	2.40*a*	....	3.40*a*
	Sap Pine or Cypress	2.20	.....	....	.....
San Francisco	Douglas Fir	1.25*bet*	.....	.....	3.00*caf*
Montreal	Birch or Maple	.....	1.65	1.04	.....

Tr.—Treated; Untr.—Untreated. *a* Creosoted. *b* 6"x8"x8'6". *c* Empty cell. *d* Zinc. *e* Green. *f* F.o.b. cars. † Out of market. *g* January 1943 price, none later available.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder in drums f.o.b. works, per 100-lb	$2.50– 3.10
Chlorine cylinders, liquid, per lb. delivered	.0525
Calcium chloride, 77–80%, flaked, 100-lb. paper bag, del'd ton	21.50–38.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb.	1.55
Soda ash, 58%, in paper bags, per 100 lb. dense	1.28
Sulphate of aluminum, commercial, in 100-lb. bags	1.15–1.20
Sulphate of copper, in bbl., per 100-lb	7.10



Motor Graders take the toughest going—meet the toughest steering conditions . . . wade through heavy earth . . . spread road materials . . . dig and clean out ditches . . . uproot old pavement. Travel is frequently very slow. Every condition is present to make steering difficult.

Caterpillar uses Gemmer Steering equipped with the Gemmer "Anti-Kick" in their Motor Graders. Gemmer high efficiency . . . smooth easy transfer of power make steering easy. The "Anti-Kick", non reversing feature keeps road reaction from reaching the operator through the steering wheel.

Gemmer Steering is easier, more efficient in any vehicle, from slow moving off the road types to high speed highway classifications. Gemmer Steering is dependable—lasts the life of the vehicle with reasonable care.

3020

CATERPILLAR TRACTOR CO
PEORIA ILL

TO
GEMMER MANUFACTURING COMPANY
IN APPRECIATION OF SERVICE
TO "CATERPILLAR" SINCE
1938

GEMMER
MANUFACTURING COMPANY
6400 MT. ELLIOTT ★ DETROIT 11, MICHIGAN

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE PARTITION — SCORED Per M lots of 2,000 pieces or over,			STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M lots of 2,000 pieces or over			BRICK Per M. in quantity		LIME		
	3x12x12 in.	4x12x12 in	8x12x12 in	8x12x12 in	10x12x12 in	12x12x12 in.	Common backing	Straight hard	Per ton, Hydrated finishing	In paper, Common hydrated	Carload lot, Pulverized or lump
Atlanta	$112.50	$132.60	$234.60	$244.80	$273.40	$306.00	$24.00	$24.00	$19.00	$17.50	$17.50
Baltimore	90.00	95.00	175.00	200.00	260.00	300.00	23.75k	29.75k	20.00	15.00	2.50m
Birmingham	97.50	104.00	195.00c	231.00	......	......	19.00	21.50	20.11	17.05	18.05
Boston	105.00†	112.00†	210.10†	252.09†	......	......	20.00i	20.00i	21.00†	.....	16.00
Chicago	92.10	98.40	185.20	x	x	x	18.50	19.50	24.00	18.00	.....
Cincinnati	......	......	......	......	......	......	.....	.....	.....	.....	.....
Cleveland	99.50	106.00	195.50	x	x	x	24.00	24.00	19.65	17.15	22.15
Dallas	.....	83.00	......	......	......	......	18.00dd	20.00dd	28.00	22.00	15.00
Denver	105.25	119.00	198.25	230.00	263.50	315.25	26.50	.....	34.80bb	28.00bb	34.00bb
Detroit	106.80	125.10	219.30	252.90	320.20	366.30	24.00f	26.00f	24.00	22.00	22.00
Kansas City	......	......	......	......	......	......	17.50	18.50	34.00	30.00	30.00
Los Angeles	r	r	r	r	r	r	18.00	20.50	21.80	18.80	22.80
Minneapolis	136.50cc	151.50cc	270.40cc	151.50wcc	......	......	21.00v	.....g	30.00bb	23.00bb	30.00bb
Montreal	92.50a	98.50a	196.25a	151.50a	......	294.40a	22.10	31.80	12.50u	14.00u	8.00u
New Orleans	104.50	109.55	207.25	222.25	326.90	385.65	17.75	.....	18.30	12.08	14.10
New York	103.90	110.80	152.35c	166.70hn	x	x	25.50	.....	28.60	22.80	.....
Philadelphia	112.10	119.60	224.20	269.10	321.20	405.10	24.75	27.75	23.10	19.10	18.10
Pittsburgh	98.50	105.80	181.85	217.30	265.85	303.10	24.00	26.00y	19.40cc	16.90cc	2.85m
St. Louis	......	......	......	......	......	......	26.00s	25.00s	.65saa	.50saa	.75z
San Francisco	116.00	130.50	174.00	130.50t	......	......	25.00	.....	22.10	22.10	2.21m
Seattle	129.25	141.50	x	141.50cc	......	......	28.50k	33.50k	27.95s	27.95s	3.28m

* F.o.b. a Smooth. b Carload lots delivered to job. c 6 x 12 x 12 in.-3 cell f Includes $3.50 per M. for delivery. g No quotation. h F.o.b Perth Amboy, N. J. i F.o.b. Warehouse only. k $1.00 discount. m Per bbl., 180 lb. n 7¾ x 7¾ x 12. Speed tile. o Per bbl., 200 lb. r Not used because of earthquake danger. s 2% discount for cash t 5½ x 8 x 11½. u 8% sales tax included. v sand lime. w 5 x 8 x 12. x Not available. y Stacked. z Pebble lime. price per 80 lb. sack. aa Price per sack. Lime recently not sold per ton. dd Price previously quoted was incorrect. This was prevailing price in Dec., Jan. and Feb. bb LCL, delivered. cc Truck delivery.

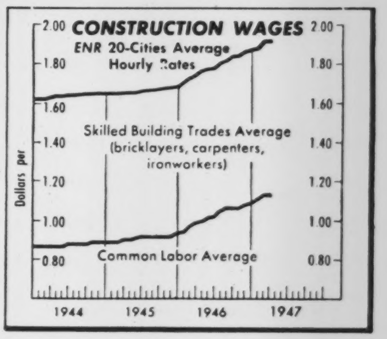
PAINT, ROOFING—F.O.B. CARLOAD LOTS

	RED LEAD Per 100 lb. in. 600-lb. (Approx.) bbl.	WHITE LEAD Per 100 lb. in 100 lb. cases	READY-MIXED PAINT			ROOFING SUPPLIES Carload lots f.o.b factory				
	Dry a	In oil w	Graphite b	Per gal., drums Aluminum c	Ferric Oxide d	Rolls, slate surfaced, 85-90 lb per sq	Asphalt felt per 100 lb	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 360 lb. bbl. per ton
Atlanta	$16.75	$24.875	$1.75	$2.70	$1.65	$2.06	$2.06	$2.06	$1.00	$36.00
Baltimore	16.50	24.50	2.00	3.00	2.50	2.35	2.90	2.90	.40	29.00
Birmingham	16.75	24.875	3.36	4.70	....	2.50	2.50	2.50	.33	30.50
Boston	16.50	24.50	1.75	2.50	2.31	2.00‡h	3.30‡ut	3.30‡ut	.25‡	21.00‡
Chicago	16.50	24.50	....	....	....	1.75h‡	2.55h‡	2.55h‡	...	29.00‡
Cincinnati	16.50	24.50	....	....	....	....	....	....	...	.....
Cleveland	16.50	24.50	3.00	3.00	3.00	2.10	2.15o	2.15o	.30y	30.00
Dallas	16.50	24.50	....	4.05	....	2.75h	2.90h	3.15h	.80	49.00
Denver	16.50	25.00	2.75	4.35	2.50	2.87	2.53h	2.53h	.35	29.00
Detroit	16.50	24.50	1.75	3.00	1.60	2.25	2.25	2.25	.50	23.00
Kansas City	16.50	24.625	3.30g	3.55g	3.16g	3.00	3.25	3.25	.67	.....
Los Angeles	16.75	25.00	2.80	4.00	3.50	2.60	1.90	....	.60	.....
Minneapolis	16.50	24.625	....	....	....	1.995i	2.0425hi	2.0425hi	.37	26.00
Montreal	.....	.....	2.90p	4.20p	3.62p	2.85	2.58t	2.07t	.68	1.85k
New York	16.50	24.50	3.45	....	3.45	1.995	2.0465o	2.0465o	.30	26.00
Philadelphia	16.50	24.50	1.75/2.00	2.40	1.70	2.54	2.94	2.94	.37	26.00
Pittsburgh	16.50	24.50	1.98	2.40	1.75	2.32	2.37h	2.37h	.37	28.00
St Louis	16.50	24.50	2.28s	2.89s	1.96s	....	....	....	....	.....
San Francisco	16.75	24.75	1.80	2.75n	1.35	1.96x	....	....	.52	21.115
Seattle	16.75	25.00	1.95	3.09	....	2.22	2.23h	....	.36	31.93j

‡ Delivered. Note: Red lead in oil 50c higher than white lead in oil. a Red lead prices change frequently due to pig lead price changes. b U. S. War Dept. Spec. 3-49A. c ASTM Spec. D266-31. d 80% minimum ferric oxide. f Distributors' price to contractors. g 55 gal. can. h Per roll, 65 lb. i Minneapolis and vicinity. j Asphalt pitch. k per cwt n May, 1941 price. o 60-lb. roll. p Plus 8% sales tax. s December, 1942 price. t Federal tax included. u 90-lb. roll. v Truck delivery. w Price to large paint contractors is $1.25 less. x Mineral surfaced. y 55-gallon container.

SKILLED AND COMMON WAGE RATES—PER HOUR

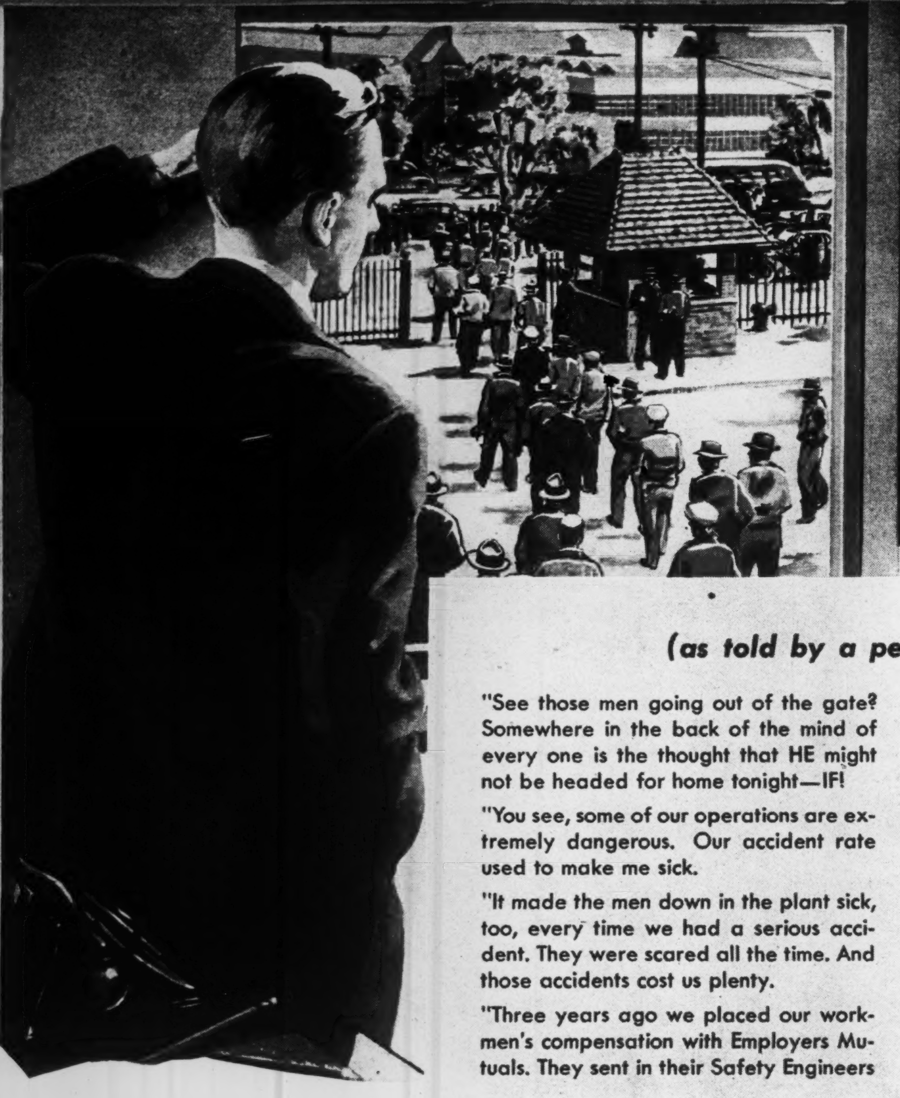
	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$2.00	$1.50	$1.75	$1.75	$2.00	$0.75	$0.85
Baltimore	2.25b	1.775	2.00	1.625/2.00	1.725	.95	.95
Birmingham	1.9375	1.50	1.75	1.50/1.75	1.875	.75	.85
Boston	1.995	1.75	1.85	1.80	1.667	1.25	1.25
Chicago	2.00	1.95	2.00	1.95	2.00	1.30	1.30
Cincinnati	.....	....	.....	.....	.....	.....	.....
Cleveland	2.125	2.00	2.125	1.55/2.125	2.125	1.275	1.375
Dallas	2.00	1.625	1.75	1.75	1.875	.90	.90/1.25
Denver	1.98b	1.70	1.70b	1.70b	1.90	1.10	1.35
Detroit	2.00	1.825	2.00	1.85/2.00	2.00	1.275	1.275
Kansas City	2.00	1.75	1.875	1.875	2.00	1.175	.90
Los Angeles	2.00	1.75	2.00	1.75	2.05	1.25	1.25
Minneapolis	1.825	1.65	1.75	1.70	1.90	1.15	1.15
New Orleans	1.625	1.375	1.625	1.55	1.625	.70	.80
New York	2.50b	2.50b	2.50	2.50b	2.50b	1.25	1.25
Philadelphia	2.00/2.25	1.775	1.90/2.00	2.25	2.00/2.25	1.025	1.025
Pittsburgh	2.15	2.00	2.00	2.05	2.00	1.15	1.15
St. Louis	2.25	1.95	2.00	2.20	2.25	1.20	1.20
San Francisco	2.25	1.75	2.00	1.85	2.25	1.25	.125
Seattle	2.105	1.805	1.93	1.95	2.105	1.405	1.30
Montreal*	1.17	1.06	1.11	1.00	1.17	.73	.73



b 7 hr. day. * Cost of living bonus now included in basic wage.

ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $1.923.

ENR Common Average: $1.123



Why

HOME

(as told by a personnel director)

"See those men going out of the gate? Somewhere in the back of the mind of every one is the thought that HE might not be headed for home tonight—IF!

"You see, some of our operations are extremely dangerous. Our accident rate used to make me sick.

"It made the men down in the plant sick, too, every time we had a serious accident. They were scared all the time. And those accidents cost us plenty.

"Three years ago we placed our workmen's compensation with Employers Mutuals. They sent in their Safety Engineers—and those fellows do know their stuff. We thought we knew something about safety—but those engineers were way ahead of us.

"Today we've got a real Safety Program. Accidents just quit happening. It seemed almost like a miracle!

"If it hadn't been for that Safety Program, one hundred and sixty-three of those men going home to supper now would have been killed this year, or laid up in the hospital, or maybe crippled for life. Right here in this plant!

"They're pretty good guys, too."

For the benefit of policyholders . . .

Employers Mutuals have a long experience as one of the largest carriers of workmen's compensation (they wrote one of the first policies ever issued). Their constant effort to provide for the welfare of policyholders has given them unusual insight into the needs of employers and of their employees.

To serve those needs, they have developed Safety Engineering and other services, in order to reduce the number of accidents to employees, and to provide care for injured employees.

You can reduce your insurance costs

All these services are available to you, to reduce your accident frequency and accident severity, thereby reducing the cost of your insurance.

In addition, all savings made through sound, conservative management, over and above provision for ample reserves and surplus, are returned to policyholders in the form of dividends—a further reduction of your insurance costs.

Employers Mutuals write:

Public Liability . . . Automobile . . . Plate Glass . . . Burglary . . . Workmen's Compensation . . . Fidelity Bonds . . . Group Health, Accident, Hospitalization . . . and other casualty insurance . . . Fire . . . Tornado . . . Extended Coverage . . . Inland Marine . . . and allied lines of insurance. All policies are nonassessable. Branch offices in principal cities. Consult your telephone directory.

EMPLOYERS
MUTUALS
of WAUSAU

163 men WILL BE FOR SUPPER TONIGHT

This leader in Safety Engineering can reduce YOUR accident rates . . . and save you money, too

Employers Mutuals nationally known achievements in Safety Engineering result from the basic principle guiding these progressive companies—to operate for the benefit of the policyholders and their employees.

E-M Safety Engineers were first put to work because high accident rates made workmen's compensation insurance costs a burden to employers. And insurance costs are only the beginning of the price you pay for accidents.

Other costs include lost production, spoiled material and broken machinery, replacement of trained workers, lowered efficiency of others who see an accident—talk about it—are fearful of their own safety.

Get safety-on-the-job

E-M Safety Engineers have developed an efficiently planned and coordinated program that can build safety-on-the-job for you—from the ground up. Engineers survey your plant to analyze the hazards surrounding your employees. Engineering specialists on various machines and industries, chemists, industrial nurses all play their part in such a survey. They make recommendations for eliminating these hazards.

Engineers help you set up a safety program. They provide practical suggestions, posters, literature, films, and other help. Safety education helps your men understand the fundamental principle of safety-on-the-job—that taking time to be safe saves time—and lives.

The Industrial Hygiene department and a staff of industrial nurses help eliminate the causes of occupational diseases. The Employers Mutual nurse will help you set up an efficient first aid department.

E-M Safety Engineering has reduced accident rates as much as 60% to 75%. Even in exceptionally hazardous industries, accidents can be brought under control.

Another service to policyholders and their employees is the effective use of modern physiotherapy laboratories when serious accidents *do* occur. Physiotherapy frequently reduces the time lost following a severe injury, and over and over again has prevented permanent disability.

Ask an Employers Mutuals man for an engineering survey of your plant and recommendations for the safety program you need to reduce your accident rates.

FREE: Write for complete information on Safety Engineering, and for a copy of "A Dictionary of Insurance Terms—How to Understand Insurance and Buy It Intelligently." Write on your business letterhead to: **Insurance Information Bureau, Employers Mutuals of Wausau, Wausau, Wisconsin.**

GET THIS E-M RISK ANALYSIS ON YOUR PUBLIC LIABILITY HAZARDS

Employers Mutuals engineers can show you, through a Survey and Risk Analysis, how to eliminate most of the hazards that might result in injury to members of the public on your premises or through the operations of your business.

Employers Mutuals combine in one comprehensive policy the several forms of public liability protection needed by manufacturing, mercantile, and contracting firms—protection against claims arising from all the usual and all the unusual chances of loss through bodily injury and damage to property of others.

Only after a survey of the hazards can the proper form of this comprehensive policy be recommended. Then, Employers Mutuals tailor the policy to provide the coverage needed.

Ask the Employers Mutuals man to make a Survey and Risk Analysis of your public liability requirements. This analysis involves no obligation.

make Insurance Understandable

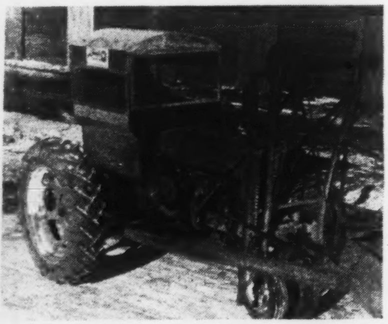
EMPLOYERS MUTUAL LIABILITY INSURANCE COMPANY OF WISCONSIN
ESTABLISHED 1911
EMPLOYERS MUTUAL FIRE INSURANCE COMPANY
ESTABLISHED 1935
Home Office: WAUSAU, WISCONSIN

New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

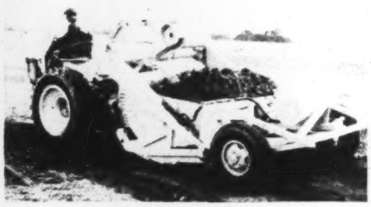
BUSINESS FORM SAMPLE—To make it possible for firms in the construction industry to examine cost-reducing systems used by comparable business organizations for consolidating and simplifying writing operations, new sample portfolios are available. Containing an extensive array of business forms utilized throughout this industry, the portfolios will suggest innumerable time-reducing and cost-cutting methods of streamlining records and procedures.—*Systems Department, Uarco Incorporated, 5000 South California Ave., Chicago 32, Ill.*

HORIZONTAL EARTH BORER—A new horizontal earth-boring tool, light enough to be operated by one man, is expressly developed for running in pipe leads. It is reported to be consistently straight-boring for underground distances up to 50 feet. Power is provided by a 3.2 hp. motor operated by 90 psi. air. The pilot bit hole of 2-in. dia. can be opened up by reaming to 3½ and 4½ in. For added handling ease, boring bar sections are only 2 ft. in length and weigh but 5 lb. each.—*Hydraoger Corp., Ltd., 116 New Montgomery St., San Francisco, Cal.*



TRACTOR CAB—Comfort and convenience for the tractor operator are combined in the new aluminum Tractorkab, a well-engineered, sturdy cab, big enough for a larger-than-average man. There is space for extra tools, gasoline and oil. It can be equipped with a heater, radio, rubber floor mat, highway horn and a rear vision mirror. Operator can stand at full height. Total weight of the cab is about 250 lb., making it easy to put on and take off the tractor, and fenders may be left on.

A heavy, waterproof canvas curtain covers the rear of the cab, automatically closed by tension springs. Large windows of crystal-clear, shatterproof plastic surround three sides and there are small windows in rear and in lower front panel. The high windshield permits full upward vision.—*Automatic Equipment Manufacturing Co., Pender, Neb.*



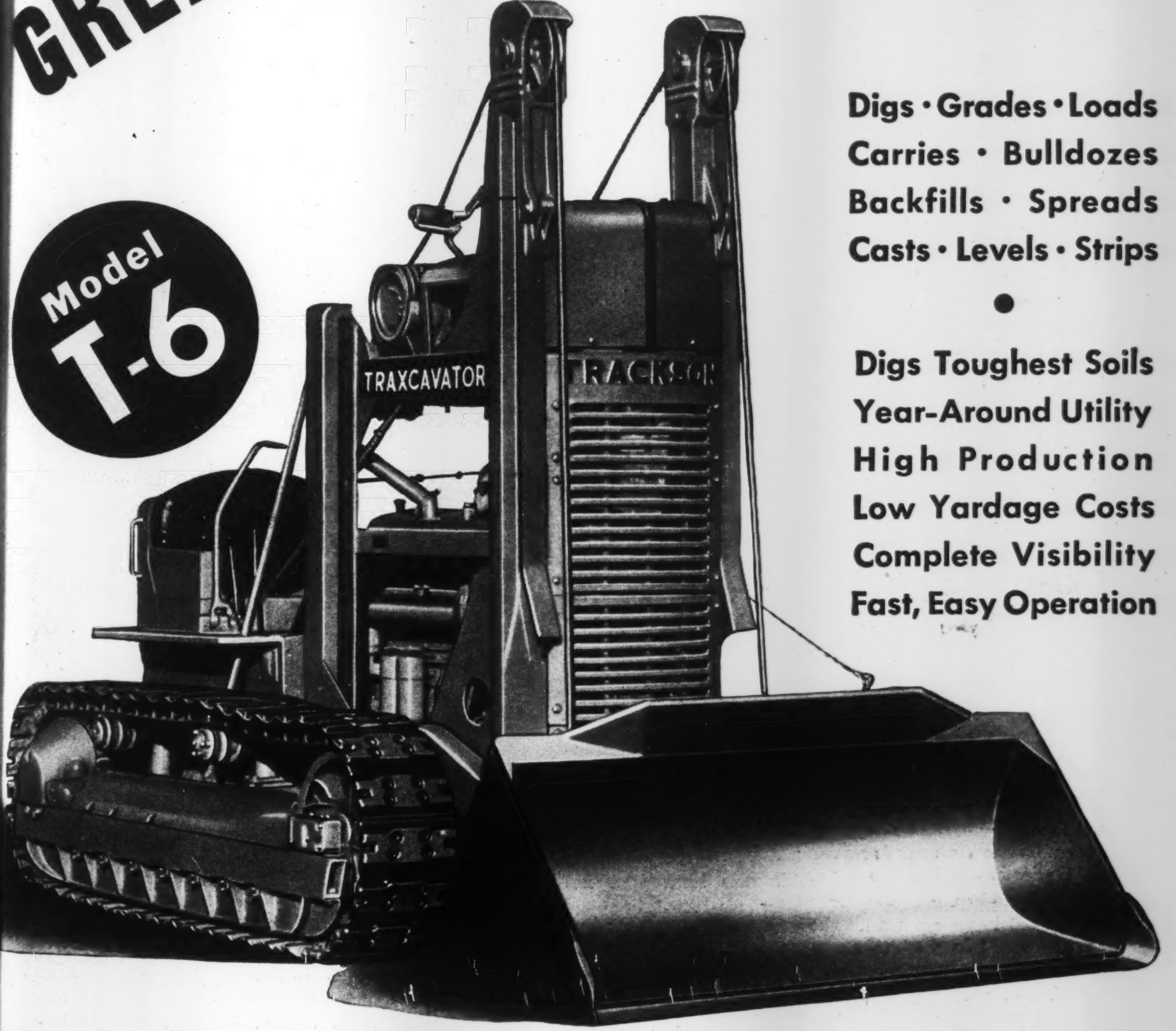
SMALL DIRT-MOVER — The new small Tournapull for high-speed dirt-moving, Model D, is powered by an 85 hp gasoline engine and equipped with the new E-4 Carryall scraper, having a load limit of 4 tons and a struck ca-

The 35,000-lb. TD24 was the feature of the International Harvester Co.'s power and equipment display held recently at the Melrose Park headquarters of the Industrial Power Division. International's complete line of crawler and wheel tractors and paver units was displayed with products of 32 other manufacturers. Construction and maintenance equipment included road rollers, diesel-powered air compressors, sweepers, mowers, snow removal equipment and motor patrols of all sizes and types. Also on display were tractors equipped with dozers, shovels, land-clearing equipment, winches, cranes, pipe-laying equipment and heavy hauling wagons.

ANOTHER GREAT TRAXCAVATOR

REG. U. S. PAT. OFF.

Model T-6



**Digs · Grades · Loads
Carries · Bulldozes
Backfills · Spreads
Casts · Levels · Strips**

●

**Digs Toughest Soils
Year-Around Utility
High Production
Low Yardage Costs
Complete Visibility
Fast, Easy Operation**

HERE'S the newest member of the famous TRAXCAVATOR family, the Model T-6 — climax of 20 years of tractor-shovel building . . . Brings to excavating, dirt-moving and material-handling fields, a new measure of multi-purpose utility and low production costs.

It mounts on the "Caterpillar" D6 tractor and is engineered to utilize most efficiently the full power, speed and work capacity of that renowned tractor . . . over 16,000 pounds of tractive effort that digs full loads in toughest soils . . . quick reverse, unequalled visibility and sure-footed balance that spells high-speed, low-cost digging, loading, grading and moving of earth or loose materials . . . ability to load big hauling units or small dump trucks with equal ease.

TRAXCAVATORS are the only full and complete line of tractor-excavators . . . there's a size for every job and purpose . . . and both TRAXCAVATORS and tractors are sold and serviced by your TRACKSON-"Caterpillar" dealer. See him today about the T-6 and other sizes of TRAXCAVATORS, or write direct for facts to TRACKSON COMPANY, Dept. EN-37, Milwaukee 1, Wisconsin.

TRAXCAVATORS ARE PROFIT-MAKERS

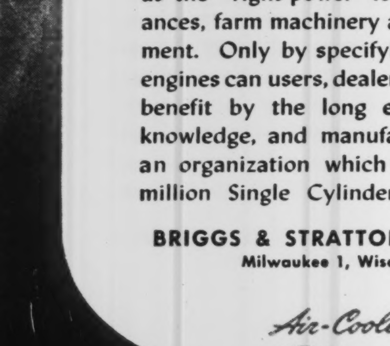
4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES

Your Assurance of All that is Best in Gasoline Engine Performance

Through more than 27 years, Briggs & Stratton 4-cycle *air-cooled* gasoline engines have demonstrated they have the stamina to give *maximum performance* under severest conditions of long, hard use. By this record of *dependable* operation, they *earned* worldwide recognition as the "right power" for all types of appliances, farm machinery and industrial equipment. Only by specifying Briggs & Stratton engines can users, dealers and manufacturers benefit by the long experience, technical knowledge, and manufacturing facilities of an organization which has built over 2¾ million Single Cylinder *air-cooled* engines.

BRIGGS & STRATTON CORPORATION
Milwaukee 1, Wisconsin, U. S. A.

Air-Cooled Power

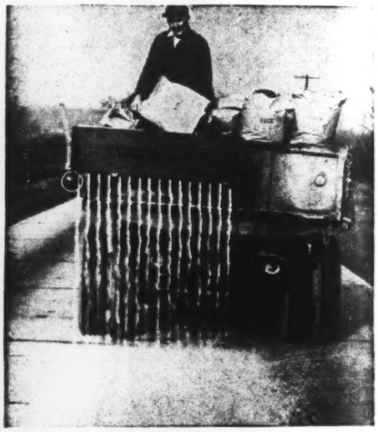


"Preferred Power"

FOR INDUSTRIAL, CONSTRUCTION
RAILROAD AND FARM
EQUIPMENT

pacity of 3.3 yd. The unit is self-loading, has 4 speeds forward, 4 reverse, and travels up to 23 mi. per hr.

A feature of this Tournapull is the new electric control by individual electric motors—a revolutionary operating principle which replaces conventional tractor steering and gear shift levers and eliminates the need of a power control unit for scraper operation. Operator steers, shifts and handles all scraper controls by buttons on the electric control panel. A new type differential keeps both wheels pulling at all times; on slippery going the most power is supplied to the wheel on firmest footing. Neither wheel will spin independently of the other. Air brakes add to safe operation. Ability to turn on a 25-ft. fill and to turn in its own length (22 ft. 5 in. from a full stop) makes this rig extremely maneuverable. A new type and size of pneumatic rubber tire is used—a 14.00 x 32 tire with tapered beads which seats itself firmly against the wheel rim at low air pressures.—*R. G. Le Tourneau, Inc., Peoria, Ill.*



ROCK SALT SPREADERS—An inexpensive, easy-to-make rock salt spreader has been developed, detailed plans for which are included in a pamphlet which may be obtained free of charge from the company. Designed to provide a controlled spread of rock salt for snow and ice removal, it hooks over the tail gate of any truck, and may be instantly attached, removed or changed from one truck to another without alterations, use of bolts or other holding devices.

The Sterling rock salt shaker consists of a metal trough with a capacity of 250 lb. of rock salt and adjustable holes in the bottom, a regulating handle to control the rate of flow and hangers to fit over the tail gate of the truck. If rock salt is shoveled into the trough instead of dumped in from bags, the back and sides should be built up higher than the front to

is NEVER UNDER-TIRED

NEVER shall it be said that "Caterpillar" equipment has "too little" of what it takes to do a job right and at lowest cost. It is the "Caterpillar" rule always to provide *more* than the severest operating conditions might demand.

Extra strength, extra-quality materials, extra protection against wear, are plainly evident in every "Caterpillar" part and mechanism. Take tires:

> ***"Caterpillar" Diesel Wheel-type Tractors and Scrapers are tired for maximum production, greatest load flotation and longest tire life.***

"Caterpillar" tire specifications have been worked out from the most intensive study of loads, traction, hauling speeds and surface conditions ever undertaken by a tractor manufacturer. They are *engineered* for the job.

Increased wheel diameters with greater tire cross-sections permit low inflation pressures under maximum loads. These features create larger "foot-print"—or bearing areas—reduce power-consuming penetration—give better traction—increase operating speeds over soft earth. Adding tire size also adds (tremendously!) to tire life on the speedier hauls over hard surfaces.

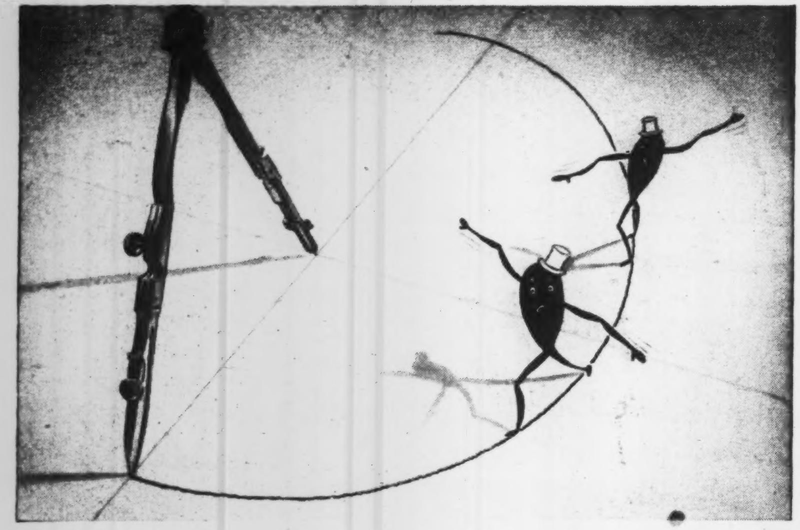
Thus, through practical engineering and job-aid recommendations, "Caterpillar" aims to make your tires as profitable an investment as the rest of your rugged, efficient and dependable "Caterpillar" Diesel Wheel-type Tractor or Scraper.

CATERPILLAR TRACTOR CO., PEORIA, ILL.

CATERPILLAR DIESEL

REG. U.S. PAT. OFF.

ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT



The Case of the

NERVOUS PERIPHERY

● The tracer had to erase a couple of times. It happens to the best of us. And when he re-inked, his periphery was definitely on the "nervous" side. Next time he'll use Arkwright.

Erasures mean little to Arkwright tracing cloth. It can take erasure after erasure without wearing through, and it re-inks without line-feathering . . . ever!

See for yourself how much better Arkwright is. Send for free working samples. Arkwright is sold by leading drawing material dealers everywhere. Arkwright Finishing Co., Providence, R. I.

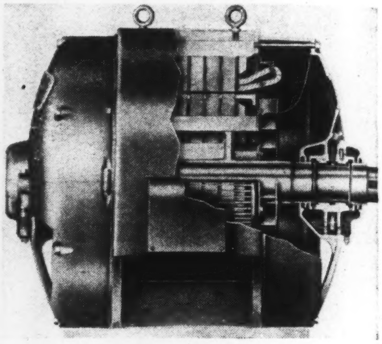
All Arkwright Tracing Cloths have these 6 important advantages

1 *Erasures re-ink without "feathering"*
2 *Prints are always sharp and clean*
3 *Tracings never discolor or become brittle*
4 *No surface oils, soaps or waxes to dry out*
5 *No pinholes or thick threads*
6 *Mechanical processing creates permanent transparency*

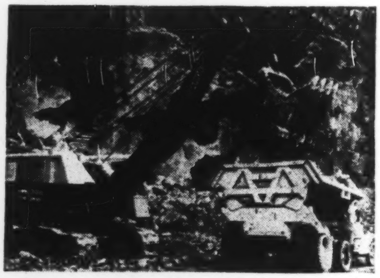
PENCIL CLOTH
TRACING CLOTH
PENCIL TRACING CLOTH

Arkwright
TRACING CLOTHS
AMERICA'S STANDARD FOR OVER 25 YEARS

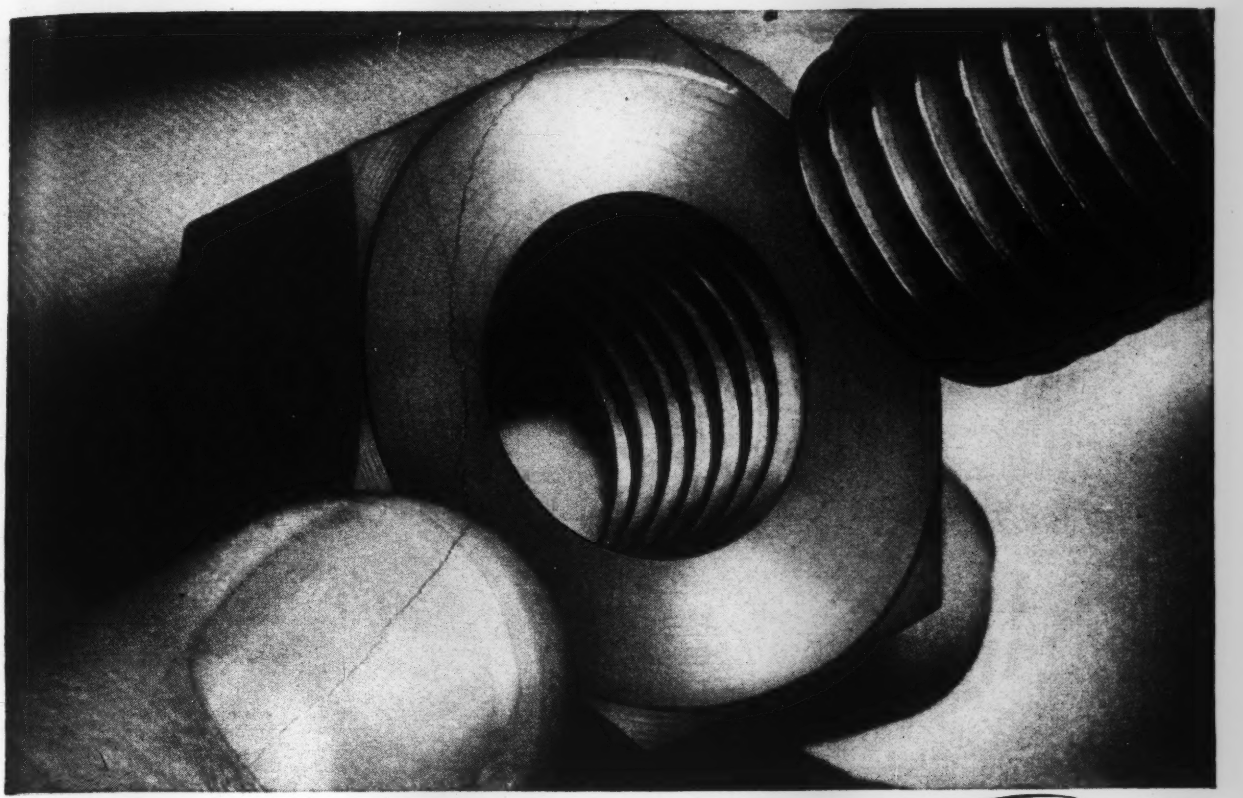
avoid spilling when the salt is thrown from the shovel. The shaker is hung as far as possible to the left side of the gate, so that it overhangs the center line of the road and distributes rock salt equally on both sides. Set to one-half the maximum capacity of the openings, it applies rock salt at a rate of 300 to 400 lb. per mi. of 20 ft. pavement at a truck speed of approximately 15 mph.—*International Salt Co., Inc., Scranton, Pa.*



SQUIRREL-CAGE INDUCTION MOTORS — Newly available heavy-duty squirrel-cage induction motors for large power drives from 100 to 1,000 hp., 1,800 rpm. and lower speeds, have a fabricated steel frame that shuts out falling particles, make operation quieter and invites easy cleaning. Inspection and blowing out is simplified on larger ratings with access plates designed for speedy removal and replacement. Sealed bearings can be cleaned and refilled without motor disassembly. Double end ventilation is provided by a blower on each end of the rotor. Starting characteristics are NEMA Class B (normal torque, low starting current), for across-the-line starting.—*Electric Machinery Mfg. Co., Minneapolis 13, Minn.*



SHOVEL DRAGLINE, CLAMSHELL, CRANE—The Marion 93-M. a heavy-duty, all-purpose shovel, dragline, clamshell and crane, is one of three new Marions since V-J Day. It is a full-rated 2½ cu. yd. machine designed for large-scale construction projects. Features include Marion air control, ease



WHEN YOU LOWER THE COST OF USING FASTENERS . . . THAT'S t.f.e.

True Fastener Economy!

Since the time and labor costs of assembly usually exceed the cost of the fasteners, it's *T*rue *F*astener *E*conomy to buy the ***type*** and ***brand*** of fastener that gives maximum speed and convenience in assembly.

R B & W *Nuts Save Assembly Time*

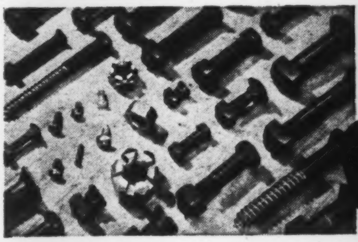
The care which RB&W takes to produce nuts with utmost accuracy and uniformity . . . pays off in terms of lower assembly cost. Careful selection of material; cold-punching that insures toughness, freedom from splitting, uniformity of size; repunching that guarantees concentricity of hole; burnishing that assures smoothness of all surfaces; tapping on machines of special design that provide accurate, clean threads . . . result in nuts that run on quickly and take severe wrenching in their stride.

You Get T. F. E. *When You*

1. Reduce building time to a minimum by savings through use of quick-assembling bolts and nuts
2. Make your men happier by giving them fasteners that make their work easier and safer.
3. Reduce the number and size of fasteners by proper design
4. Use the fastening method—bolts and nuts—which involves minimum indirect labor, noise and confusion
5. Purchase maximum holding power by capitalizing upon the high residual tension set up by bolt-and-nut fastening
6. Simplify inventories by standardizing on fewer types and sizes of fasteners.
7. Save purchasing time by buying larger quantities from one supplier's complete line
8. Assure yourself of satisfactory fastener performance by using a source of supply with a reputation for dependability

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

102 years making strong the things that make America strong

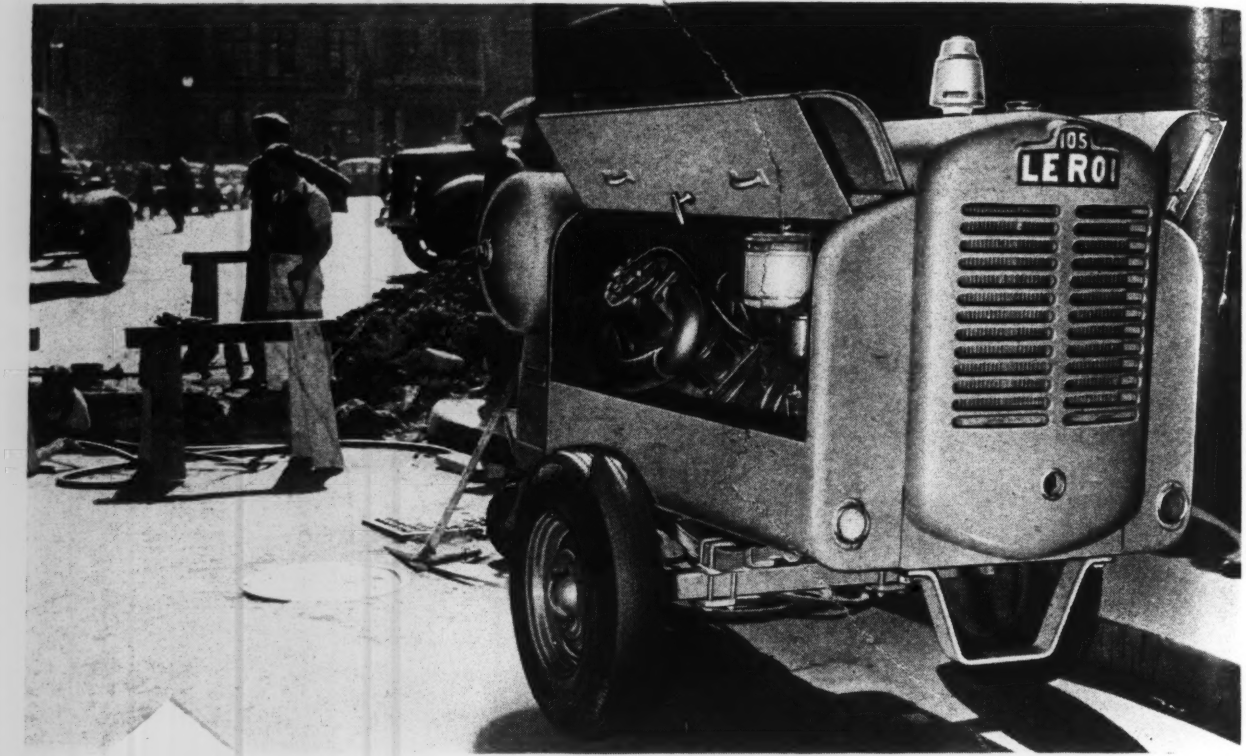


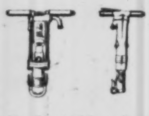
RB&W
THE COMPLETE
QUALITY LINE

RB&W bolts, nuts, screws, rivets and allied fastening products are manufactured in a broad range of styles, sizes and finishes.

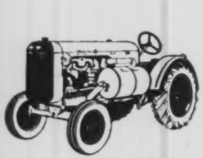
• • •

Plants at: Port Chester, N. Y., Coraopolis, Pa., Rock Falls, Ill., Los Angeles, Calif. Additional sales offices at: Philadelphia, Detroit, Chicago, Chattanooga, Portland, Seattle. Distributors from coast to coast. By ordering through your distributor, you can get prompt service from his stocks for your normal needs. Also—the industry's most complete, easiest-to-use catalog.

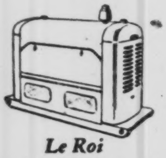




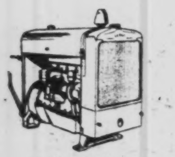
Le Roi-Cleveland Rock Drills



*Le Roi 105 Tractair**



Le Roi Engine-generaor set



Le Roi Heavy-duty engine

How to put your best foot forward

Air-power your tools with LE ROI AIRMASTERS ... for greater economy, less trouble, lower costs

Today, normal profits rapidly disappear in the face of rising costs. That is why construction men everywhere are streamlining their operations — effecting economies, large and small, wherever possible.

One of the easiest ways of cutting costs is to use Le Roi AIRMASTER compressors. Find out for yourself that they make air power with the least possible expense — provide higher average working pressures so that air tools do more work — greatly reduce maintenance costs because they are designed and built so sturdily and efficiently. AIRMASTER* users call them "portable air power at its best."

Here are a few reasons why:

- **Patented, Fuel-saving Econotrol*** adjusts engine speed to the demand for air. Rapid acceleration and deceleration are done away with — increasing endurance, lowering fuel consumption, and reducing costs. Higher average working pressures are maintained so that air tools do more work.
- **Tough, Cushioned, Super-finished AIRMASTER Valves** provide the most efficient, trouble-free means of delivering air. They are individually magnafluxed, and the accuracy of their seating surfaces is measured in microns — accounting for their long life and high efficiency.
- **Electric Hour Meter** keeps track of compressor operating-time, and provides proof of AIRMASTER dependability.
- **Push-button Electric Starting** gives you air quickly and easily.
- **The Automotive Steering and Semi-elliptical Spring Suspension** make possible easy maneuvering and towing.
- **Full-length Tool Boxes and Lockable Side Panels** protect your tools — you can always find them when needed.

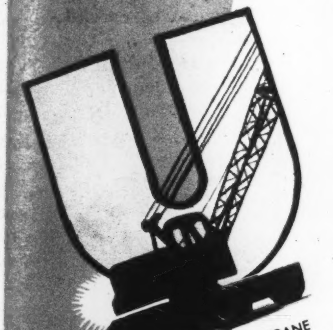
So put your best foot forward — reduce the cost of your air power. Use AIRMASTERS on your job — in the size range from 60 to 500 cfm you can find the unit best suited to your work, either gasoline- or diesel-powered. Call on your nearby Le Roi distributor — he's listed in the phone book — and for further information, write for latest bulletins.

LE ROI COMPANY
MILWAUKEE 14, WISCONSIN
New York • Washington • Cleveland
Milwaukee • Birmingham • Tulsa
Butte • San Francisco

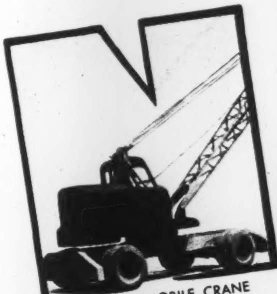
LE ROI
MILWAUKEE

C-112

*Reg. U.S. Pat Off.

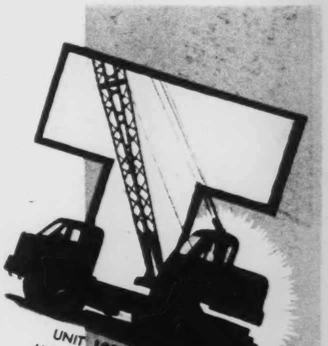


UNIT 1020 MOBILE CRANE
WITH 3 AXLE UNDERCARRIAGE
10 TON CAPACITY



UNIT 1020 MOBILE CRANE
WITH 2 AXLE UNDERCARRIAGE
10 TON CAPACITY

UNIT 357 MOBILE CRANE
WITH 2 AXLE UNDERCARRIAGE
5 TON CAPACITY

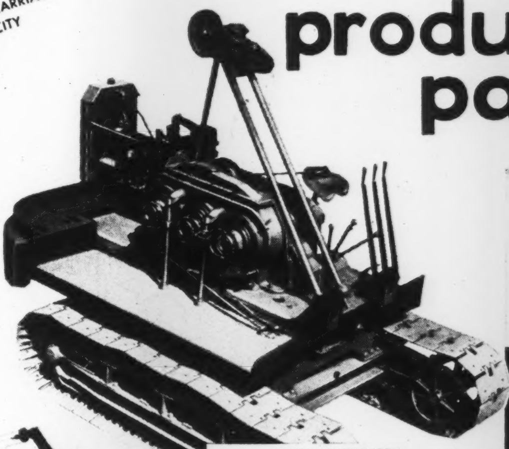


UNIT 1020 TRUCK CRANE
MOUNTED ON 3 AXLE TRUCK
10 TON CAPACITY

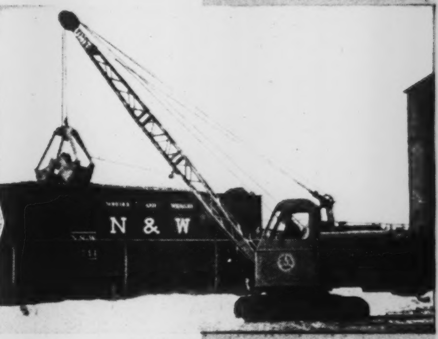
production parade

**½ AND ¾ YD.
EXCAVATORS**

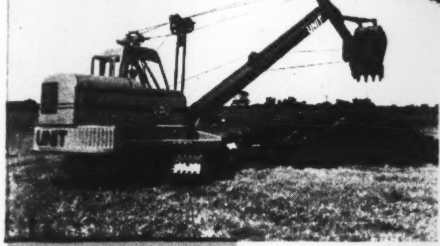
5 TO 10 TON CRANES



MAIN MACHINERY
AUTOMATIC TRACTION BRAKES
STRAIGHT LINE ENGINE MOUNTING
ONE PIECE CAST GEAR CASE



UNIT 514 . . . ½ YD.
CLAMSHELL



UNIT 1020 . . . ¾ YD.
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CONTACT
FACTORY
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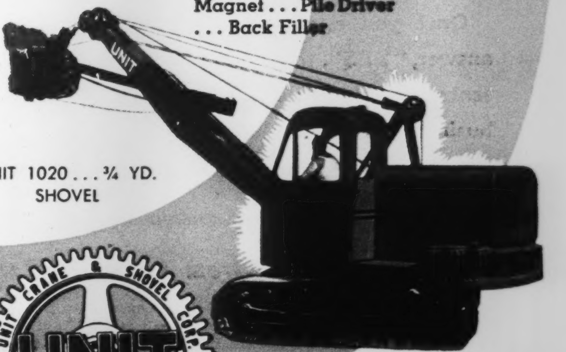
Full-Vision Cab **. . ENABLES
OPERATOR TO SEE IN ALL DIRECTIONS**

Convertible **TO ALL
ATTACHMENTS**

**Shovel . . . Clamshell
Dragline . . . Trenchoe
Magnet . . . Pile Driver
. . . Back Filler**

UNIT 514 . . . ½ YD.
DRAGLINE



UNIT 1020 . . . ¾ YD.
SHOVEL

UNIT CRANE & SHOVEL CORP.

**MILWAUKEE 14,
WISCONSIN, U.S.A.**

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On the Proposed
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CONSTRUCTION CO.
MEMO
Call Ætna Agent re Contract Bond on this job!

Contract Bond Service
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The building industry is looking forward to the biggest expansion in history. Are you prepared to get your share of this business?

Specifically, have you consulted your Surety as well as your banker to make sure that your organization is equipped to take advantage of this expanded program? Are you prepared to furnish a Bond that is acceptable on public or private jobs in any part of the country? Has your Surety Company a Washington Bureau and other *extra* services to conserve your time in this busy period? Does your Surety have representatives throughout the country to show you the ropes in a strange town?

Once you establish your standing with the Ætna, you can answer, "YES", to all these questions. Ask your local Ætna representative to call now. He can help you get set for the expected business ahead.

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of convertibility, ease of shipment, simplicity and accessibility of all machinery and moving parts, careful proportioning.

Shovel front-end equipment includes an all-welded, rounded-edge, box section boom, twin welded full box section dipper handles and a heavy duty manganese-steel-front dipper with inserted, socket-type dipper teeth. For dragline or clamshell service, varying boom lengths and bucket combinations are available. A live boom hoist is standard equipment.—*Marion Power Shovel Co.*

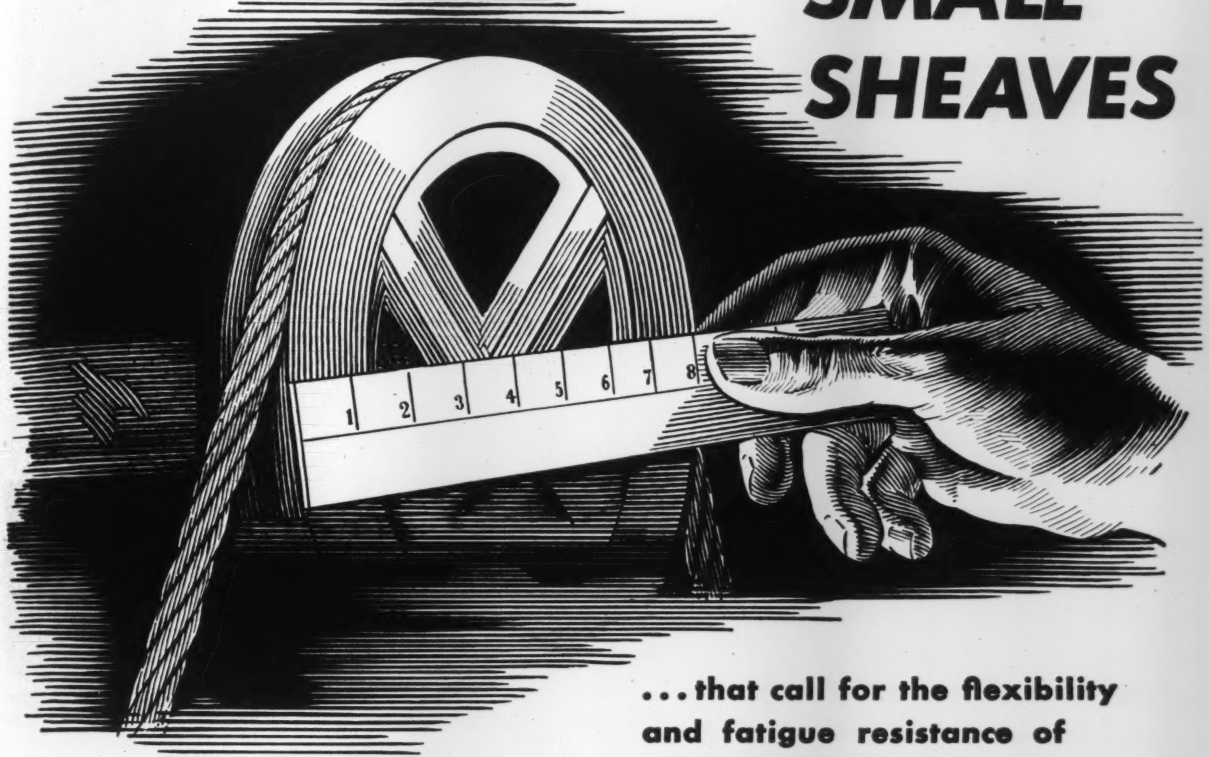
STEEL PUMPS—A new line of Rex press-formed self priming centrifugal pumps combine attractive appearance with many features of construction that are unique in self priming centrifugal pump design. The pump body is press formed of Armco ingot iron which is highly resistant to corrosion. There is a great saving in weight. The press-formed pump body resists cracking or shattering under heavy blows—or in freezing weather. It can usually be repaired readily by welding.

Pumping efficiency has been improved, due, in part, to the smooth surface of the pump and press-formed volute, resulting in a smoother flow of water through the pump. A fast prime is assured.—*Chain Belt Co., 1600 West Bruce St., Milwaukee 4, Wis.*

EXPANSION JOINT SLITTER—A unit for slitting all types of expansion joints, driven by a 1 hp. electric motor, or gasoline motor, cuts all joint materials up to 1½ in. thick at 60 ft. per min. The Keystone expansion joint slitter, modern and streamlined in every way, can be simply plugged in and operated by one man. Forward and reverse operation permits cutting in either direction. —*Keystone Asphalt Products Co., 43 East Ohio St., Chicago 11, Ill.*

We still have with us . . .

SMALL SHEAVES



. . . that call for the flexibility and fatigue resistance of *PREFORMED* YELLOW STRAND

In a lot of equipment lines, old and new models will have one feature alike: small sheaves—perhaps accompanied by small drums. Either is tough on wire rope. Both should remind you to *minimize* their fatiguing effect by using *Preformed* Yellow Strand.

While reasonable bending is expected of unpreformed rope, severe bending tends to break down the steel itself. High speeds, heavy loads and reverse bends all hasten a premature end.

The *flexibility* of *Preformed* Yellow Strand enables it to hold its own *longer* against fatigue. Its wires and strands can concentrate on the *external* bending job, because *internal* stresses have been virtually neutralized during manufacture. Instead of having been forcibly twisted into place, the parts have been preshaped to the spiral curvature they keep in the finished rope.

Along with greater endurance, smooth-running *Preformed* Yellow Strand offers faster installation . . . higher kink-resistance . . . increased protection for workmen.

Specify *Preformed* Yellow Strand by name. Get all you should in wire rope performance and economy. Broderick & Bascom Rope Co., St. Louis 15, Mo. *Branches:* New York, Chicago, Houston, Portland, Seattle. *Factories:* St. Louis, Seattle, Peoria.

HAND BOOK FREE: "Industrial Wire Ropes" contains useful facts, tables, pictures. Write for your copy.

BRODERICK & BASCOM
Yellow Strand
PREFORMED WIRE ROPE

When something is needed "yesterday" Specify Air Express delivery

Here's the fastest solution to the problem of supplies and parts that are "fresh out"—get them by Air Express. This super-speedy service places even the most distant supplier only hours from your business.

Speeds up to five miles a minute now make coast-to-coast and overseas deliveries a routine affair for Air Express. And now it's a better value than ever before. The cost of shipping by speedy Air Express is *low.*

Specify Air Express-it's Good Business

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Rates are low

To Air Express a 10-lb. package **1549** miles costs only **$4.65!** Heavier weights are similarly inexpensive. Investigate!

Men and Jobs

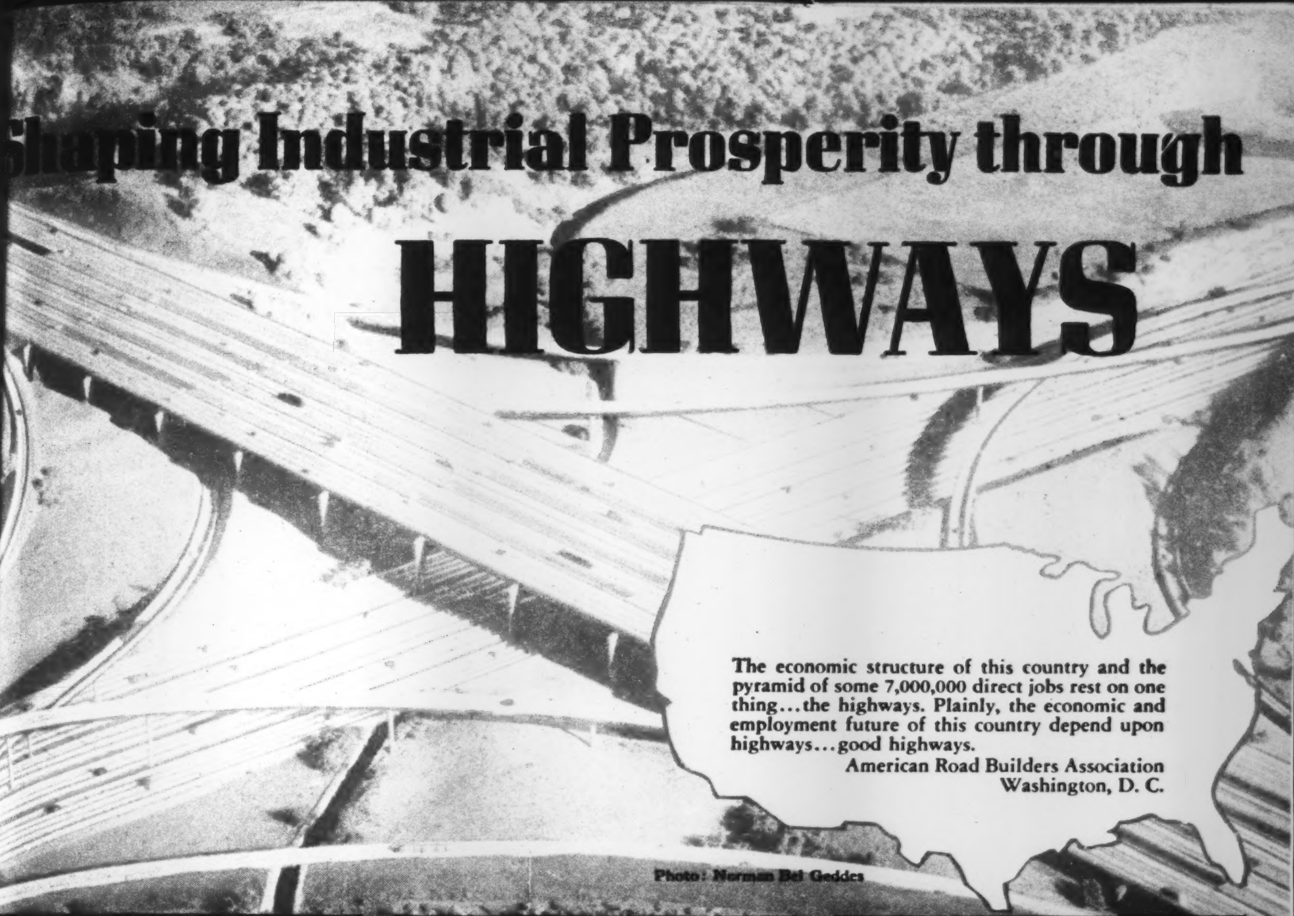
Frank M. Williams, Ohio district engineer for the Clay Sewer Pipe Association, has been appointed assistant chief engineer of the Ohio State Highway Department. In his work with the organization of eastern clay pipe manufacturers with headquarters in Columbus, Mr. Williams assisted state, county, municipal and industrial engineers in solving storm and sanitary sewer problems. Mr. Williams joined CSPA early last year after three years of service with the United States Army. A captain in the Signal Corps, he served in the Pacific Theater. Previous to entering the service he had been with Ohio's highway department for several years.

Robert H. Harmesson, Mattoon, Ill., has been named sanitary engineer of district No. 6, Illinois State Department of Public Health. He is a graduate in sanitary engineering of the University of Illinois, 1941. He served as sanitary engineer for the Will County (Joliet) Ill., Public Health Department, then spent four years in the air force as a B-17 pilot.

Glenn R. Logue, Columbus, has been named chief engineer of the bureau of bridges for the Ohio Highway Department. He was graduated from Ohio State University in 1913 as a civil engineer, and during the last two years he served as president of the Mississippi Valley Conference of State Highway Departments. Formerly he was assistant director of the Ohio highway department, and recently was director of construction in the Kentucky Highway Department. He also served as engineer and bridge designer, chief engineer of location and design, and chief engineer of bridges in the state department, and for six years he was bridge engineer of Franklin County.

George J. Thormyer, Columbus, has been named chief engineer of the bureau of location and design of the Ohio Highway Department, succeeding Charles G. McKee. A graduate of Purdue University, he has been connected with the bureau of location and design since its organization, and for

haping Industrial Prosperity through HIGHWAYS

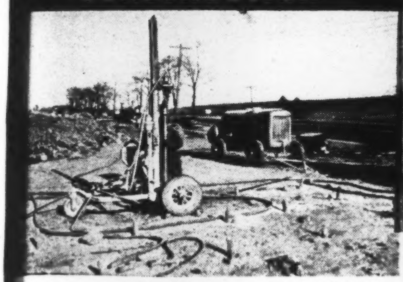


The economic structure of this country and the pyramid of some 7,000,000 direct jobs rest on one thing...the highways. Plainly, the economic and employment future of this country depend upon highways...good highways.

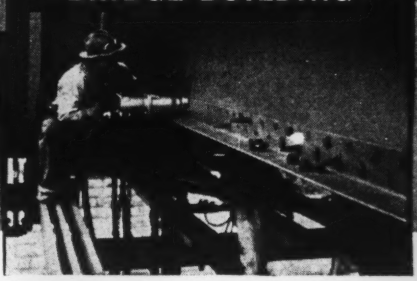
American Road Builders Association
Washington, D. C.

Photo: Norman Bel Geddes

CONSTRUCTION



BRIDGE BUILDING



MAINTENANCE

"When a road is once built, it is strange how it collects traffic." How true, except for the word, "strange," for since the early days our civilization has followed the highways. No nation has been truly prosperous without an efficiently planned system of "better" roads and streets.

Right now we must go to work on our highways—build new roads, relocate others and repair those that have suffered due to war conditions. The Public Roads Administration estimates that the minimum expenditure for construction and maintenance of the nation's roads and streets will total $7,500,000,000 in the next four years. This huge and very essential program means work for thousands of road builders, bridge builders and engineers; for the manufacturers of roadbuilding machinery and for suppliers of rock, cement, steel and other materials. The finished product means safer driving, greater use of cars and trucks, real estate development, increased tourist trade—greater National Prosperity.

Because roadbuilding means rock removal, the name INGERSOLL-RAND has been closely associated with roadbuilding for three quarters of a century. I-R rock drills, paving breakers, diggers, tampers, hammers and hoists are operated by compressed air from INGERSOLL-RAND Compressors and have set new standards for roadbuilding and maintenance work.

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Ways to do it

ROCK DRILLS • AIR COMPRESSORS • OIL ENGINES • AIR TOOLS AND HOISTS • CENTRIFUGAL PUMPS • BLOWERS

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11 BROADWAY, NEW YORK 4, N. Y.

Control!

YOUR MAINTENANCE COSTS WITH THIS SELF OILING FEATURE

It costs hard, cold dollars to constantly make the rounds to oil hydrants—a needless expense that you can eliminate, as the MUELLER-COLUMBIAN Hydrant OILS ITSELF!!!

The unique construction of the Dry Top Bonnet Section utilizes an oil reservoir that keeps all working parts constantly immersed in an oil bath. No corrosion, no binding of parts, and easy, quick operation every time. Ask any Mueller Representative for full details, or write direct.

DEPENDABLE SINCE 1857 FULLY WARRANTED OUR 90th YEAR

MUELLER CO.

MAIN OFFICE AND FACTORY DECATUR, ILLINOIS
OTHER FACTORIES: Los Angeles, Cal.; Chattanooga, Tenn.; Sarnia, Ont. Canada

the last several years has served as engineer of plans.

Robert F. Wirsching has resigned as director of state parks for the Indiana department of conservation and will open an office in Indianapolis as a park and recreation planning consultant.

Albert A. Mittag has resigned as chief of the engineering division, Panama Engineer District, and at the expiration of his terminal leave will join the firm of Constructora Martinz, S. A. as general superintendent in charge of all construction. He was graduated from Cooper Union and has had a varied experience in design, construction and consulting work on highways, structures and airports from Mexico to Peru. In 1935 and 1936 Mr. Mittag was with Pan American Airways on the general design of Pacific bases at Midway, Wake and Guam and in active charge of construction at Midway and Guam.

E. N. Rodgers, formerly acting state highway director, has been named engineer-manager of the Alabama Road Builders Association.

Wade L. Stever has been appointed Defiance County, Ohio, engineer, to succeed Earl L. Reeb who resigned to become chief engineer of the Bureau of Maintenance, Ohio Department of Highways, Columbus. Stever previously served as county deputy engineer, and before that was an engineer for 18 years with the late Roger Daoust, road contractor.

R. H. Weller has returned from Army service and is with the Nebraska state highway commission, now working as state airport engineer under the aeronautics commission. Before entering the Army, Weller was assistant construction engineer for the highway department, and at one time served as district engineer.

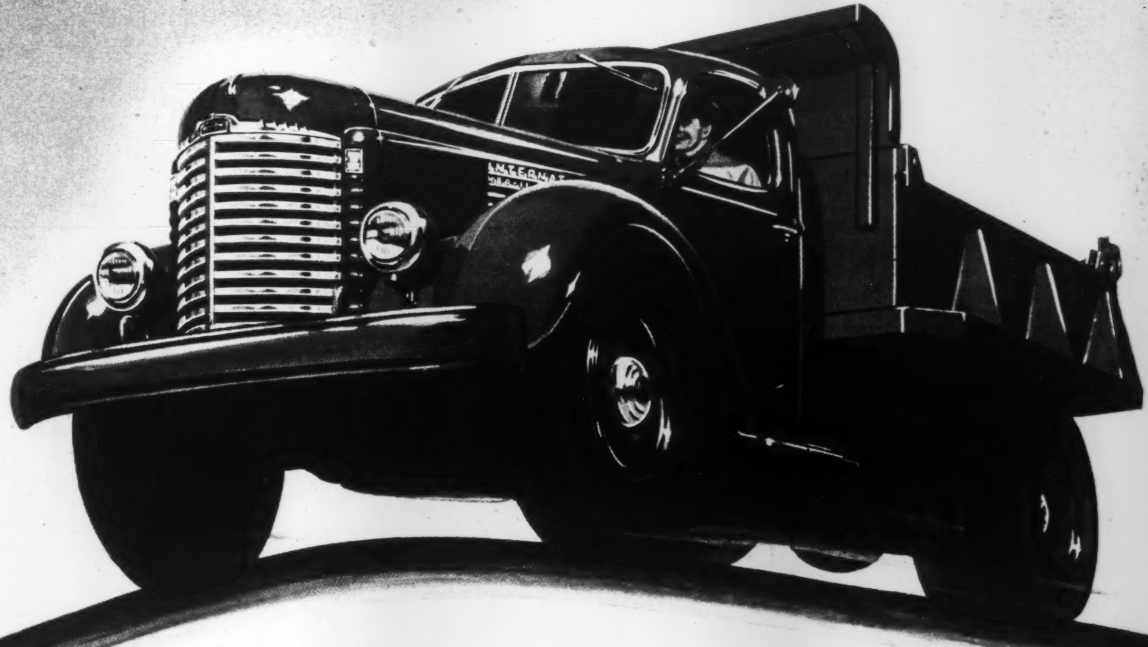
Robert R. Gehrend has been named city engineer of Ripon, Wis., to fill the vacancy caused by the resignation of Alex Kessler.

Arthur W. Carlson, Burlingame, Calif., has been appointed bridge engineer of the Western Pacific Railroad. He received bachelor's and master's degrees at Montana State College and the

NOW!

The Finest Values in 40 Years of International Truck History

New INTERNATIONAL *Trucks*



For 16 years more heavy-duty International Trucks have served American commerce and industry than any other make.

Now come *new* KB Models—light-duty, medium-duty and heavy-duty—with gross vehicle weight ratings from 4,400 to 35,100 pounds. Note the designation—KB.

That means many features and improvements... new goals in engineering, research, and design... new styling with trim, flowing lines accented by gleaming chrome.

And that means rugged International stamina, long, trouble-free life, and ease and economy of operation in greater abundance than ever before.

Yes, KB Internationals are the finest trucks in 40 years of International Truck history. In the complete line is the right truck for every job. And back of every truck is service as great as the trucks themselves, supplied by the nation's largest company-owned truck service organization—International Branches—and thousands of International Dealers.

Motor Truck Division
INTERNATIONAL HARVESTER COMPANY
180 N. Michigan Ave., Chicago 1, Illinois

THIS EMBLEM IDENTIFIES GREAT TRUCKS

INTERNATIONAL

Tune in James Melton on "Harvest of Stars" every Sunday! NBC Network. See newspaper for time and station.

INTERNATIONAL INTERNATIONAL **TRUCKS**

Worthington-Ransome Blue Brute Distributors

See ad on page 127 for list of equipment in each line

Worthington-Ransome Distributors

Ala., Birmingham, Construction Equipment Co.
  Montgomery, Burford-Toothaker Tractor Co.
Alaska, Anchorage, Airport Mach. & Storage Co.
Ariz., Phoenix, Lee Redman Equipment Co.
Ark., Fort Smith, R. A. Young & Son
  Little Rock, R. A. Young & Son
Cal., L. A. Golden State Equip. Co.
  San Francisco, Coast Equip. Co.
Colo., Denver, Power Equipment Co.
Conn., Wallingford, Wilhelm-Davies Co., Inc.
Fla., Gainsville, Constr. Equip. & Supply Co., Inc.
  Orlando, Highway Equipment and Supply Co
  Tampa, Epperson & Company
Ga., Atlanta, Tractor & Machinery Company
Ida., Boise, Olson Manufacturing Co.
Ill., Chicago, Chicago Construction Equip. Co.
Ill., Chicago, Thomas Hoist Co.
Iowa, Cedar Rapids, McNall Mach. & Supply Corp
Ill., Chicago, J. A. Roche
Ky., Harlan, Croushorn Equip. & Supply Co.
  Louisville, Williams Tractor Co.
Maine, Portland, Maine Truck-Tractor Co.
Mass., Allston, Boston, Clark-Wilcox Co.
Mich., Muskegon, Lakeshore Machy. & Supply Co
Minn., Minneapolis, Phillippi-Murphy Equip. Co.
Miss., Jackson, Jackson Road Equip. Co.
Mo., Clayton, The Howard Corporation
Mo., Kansas City, Machinery & Supplies Co., Inc.
  St. Louis, W. H. Reaves
Montana, Billings, Interstate Truck & Equip. Co.
  Helena, Caird Eng. Works
Nevada, Elko, C. W. Paul Hardware
N. J., No. Bergen, American Air Comp. Corp.
N. M., Albuquerque, Bud Fisher Co.
  Roswell, Smith Machy. Co.
N. Y., Albany, Milton-Hale Machinery Co.
  New York, Hodge & Hammond, Inc.
  New York Railroad Materials Corp.
  Syracuse, .lton-Hale Mach. Co.
N. C., Raleigh, Smith Equip. Co.
N. D., Fargo, Smith Commercial Body Works, Inc
Ohio, Cincinnati, Carroll-Edwards & Co.
Dayton, Carroll Edwards & Co.
Oregon, Portland Andrews Machinery
Pa., Wilkes-Barre, Ensminger & Co.
  Mechanicsburg, American Equip. Corp.
  Philadelphia, Metalweld, Inc.
S. C., Columbia, Smith Equipment Co
Tenn., Knoxville, Dempster Bros., Inc.
  Memphis, Independent Tractor Co.
  Nashville, Dempster Bros., Inc.
Tex., Amarillo, T. W. Carpenter Equip. Co.
  Dallas, Shaw Equip. Co.
  Houston, Contractors Equip. Sales & Service Corp
  San Antonio, Patten Machy. Co.
  Tyler, D. M. McClure Equip. Co.
Utah, Salt Lake City, J. K. Wheeler Mach Co
Vt., Barre, A. M. Flanders, Inc.
Wash., Spokane, Andrews Equip. Service
Va., Richmond, Highway Machy. and Supply Co.
W. Va., South Charleston, Allied Equip. Co.
Wisc., Milwaukee, Drott Tractor Co., Inc.

Ransome Distributors

Ark., Fort Smith, Central Welding Equip. Co.
D. C., Washington, M. A., Doetsch Mach. Co.
La., New Orleans, Ole K. Olson Co.
Md., Baltimore, Stuart M. Christhilf & Co.
Mich., Detroit, T. G. Abrams
Mich., Detroit, Welding Equip. & Supply Co.
N. Y., Buffalo, Murray Equip. Co.
N. Y., Rochester, B-G Equip. Co.
Pa., Pittsburgh, Arrow Supply Company
O., Cleveland, H. B. Fuller Equip. Co.

Worthington Distributors

Ind., Indianapolis, Reid-Holcomb Company
La., New Orleans, Wm. F. Surgi Equip. Co.
Md., Baltimore, D. C. Elphinstone, Inc.
Mass., Cambridge, Field Mach. Company
Mich., Detroit, W. H. Anderson Co., Inc.
  Flint, Gransden-Hall & Co.
N. Y., Buffalo, Dow & Co., Inc.
  New York, Air Compressor Rental and Sales
O., Cleveland, Gibson-Stewart Co.
  Toledo, The Kilcorse Mach. Co.
Pa., Allentown, H. N. Crowder, Jr., Inc.
  Pittsburgh, Atlas Equip. Corp.
Texas, El Paso, Equip. Supply Co.
Washington, Seattle, Star Machinery Co.
Wyoming, Cheyenne, Wilsen Equip. & Supply Co.

Buy Blue Brutes

Worthington Pump and Machinery Corp.
Worthington-Ransome Construction Equipment Division
Holyoke, Massachusetts

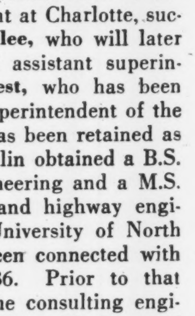
University of California, respectively, entering employ of the railway in 1937 as a draftsman. He was promoted to structural draftsman in 1941 and to assistant bridge engineer in 1944.

E. Albert Gast, consulting civil engineer, who has been secretary of the Engineering Society of Cincinnati, Ohio, for 40 years, was honored at a dinner recently. The society has a membership of 1500.

Thomas E. Kimbrough has been named first assistant to Maj. A. Kroeber, chief of plans and development section, Air Installation, Eglin Field, Fla., where he has held the position of construction engineer since being transferred from Courtland Army Air Field, Courtland, Ala., 18 months ago. After leaving private contractors 20 years ago he has been employed by the government in the Army Engineers, Army Air Corps, Fish Wildlife Service, Tennessee Valley Authority, Maritime Commission and Department of the Interior.

Walter M. Franklin, chief sanitary engineer and superintendent of the municipal plant system at Charlotte, N. C., has been named superintendent of the city water department at Charlotte, succeeding **J. L. Greenlee,** who will later assume the title of assistant superintendent. **W. E. Vest,** who has been serving as acting superintendent of the water department, has been retained as a consultant. Franklin obtained a B.S. degree in civil engineering and a M.S. degree in sanitary and highway engineering from the University of North Carolina and has been connected with Charlotte since 1936. Prior to that time he was with the consulting engineering firm of William M. Piatt of Durham, N. C., and helped supervise the building of the Charlotte plant and sewage outfall system. During the war he served as a major with the Army Medical Corps sanitary forces and helped direct the reconstruction of water and sewer facilities in the Philippines.

Charles H. Carter has been appointed engineer for Region 4 of the Bureau of Reclamation. He has been acting chief design engineer since February, 1946, when he was discharged from the Corps of Engineers after three years service with the rank of captain as post engineer at the California Quartermaster Sub-Depot in charge of post utilities and construction. He was graduated from Utah State Agricultural College with a civil engineering degree, working as hydrographer and engineer with the North Side Canal Co., Jerome, Ida., for five years before joining the bureau as assistant office engineer at Echo Dam. Two years later he became assistant engineer, concrete and earth dams section, in Denver, and in 1935 went to Washington, D. C., as associate engineer in the engineering division. Returning to Utah in 1937, he was named office engineer for Utah construction projects.



U. S. Steel's American Bridge Co., Gary, Ind., has announced the promotion of **Gerald E. Rhodes** to assistant manager of the plant. Since 1943 he has served as assistant to the manager, William A. Thiel. Mr. Rhodes succeeds Jay K. Thompson, who has retired after 44 years' service. He was graduated from Notre Dame University in 1927, and after other industrial experience joined the American Bridge Co. in 1931.

Material Service Corp., Chicago, Ill., has announced the election of **Col. Harry A. Montgomery,** formerly division engineer, Great Lakes Division, Corps of Engineers, Chicago and recently chief engineer American Forces, Western Pacific, Manila, P. I., as vice president and chief engineer.

George Wallace Carr and **Clark C. Wright** have formed Carr and Wright, Inc., engineers and architects, succeeding Nimmons, Carr & Wright at 333 North Michigan Avenue, Chicago 1, Ill.

Homer E. Anderson, who returned from Army duty in Japan in January, has been appointed chief engineer of the bureau of construction of the Ohio Highway Department, at Columbus. He was chief of Division No. 4, Ravenna, until he entered the Army in 1942. He served in Europe and Japan and held the rank of colonel.

Earl L. Reeb, Hicksville, has been named chief engineer of the bureau of maintenance of the Ohio Highway Department in Columbus. Mr. Reeb has been Defiance County engineer.

Ray Warren, former city engineer of Greensboro, N. C., and former executive director of the Greensboro Housing Authority, has been separated from

BREAK IT UP FASTER WITH BLUE BRUTES

WORTHINGTON
Blue Brute

Your bids for jobs involving paving breaking carry extra profit margins when you have Blue Brute Compressors and Air Tools lined up for the work. Utility pipe lines . . . street construction and repair . . . are "naturals" for these Blue Brute Teams.

Look at Blue Brute Compressors — hard-muscled "portable cyclones" that take the roughest going . . . and come back for more. They develop full rated output right through the grind . . . and have plenty of reserve for the hard pulls. Yes, Blue Brute stamina is *built* in . . . full force-feed lubrication in engine and compressor . . . Feather* Valves for efficient air control and less maintenance . . . 3-point suspension of engine and compressor in a unitized housing cushions shocks and vibration . . . New Fuel Saver accurately regulates fuel according to demand — gives you the most air from each gallon of fuel.

Investigate Blue Brute Paving Breakers, matched partners for Blue Brute Compressors: WB-50 — a fast middleweight for the lighter jobs; WB-81 — a rapid fire heavyweight that packs terrific power; WB-85 — a super slugger that tears into *anything*.

For a combination that will keep you consistently ahead of schedule — and competition — go to your Blue Brute distributor. He'll show you the models best suited to your jobs . . . and prove to you *there's more worth in Worthington-Ransome.* H7-4

*Trade Mark Registered

KNOW YOUR

BLUE BRUTES

Your Blue Brute Distributor will be glad to show you how Worthington-Ransome construction equipment will put your planning on a profitable basis. His name is listed on Page 126.

RANSOME EQUIPMENT

Pavers, Portable and Stationary Mixers, Truck Mixers, Pneumatic Placing and Grouting Equipment and Accessories.

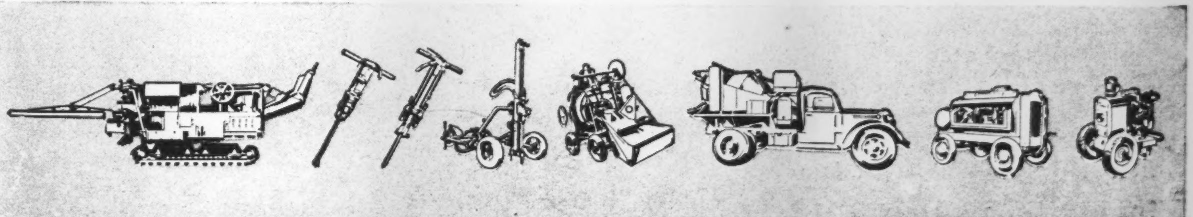
WORTHINGTON EQUIPMENT

Gasoline and Diesel Driven Portable Compressors, Rock Drills, Air Tools, Self-Priming Centrifugal Pumps and Accessories.

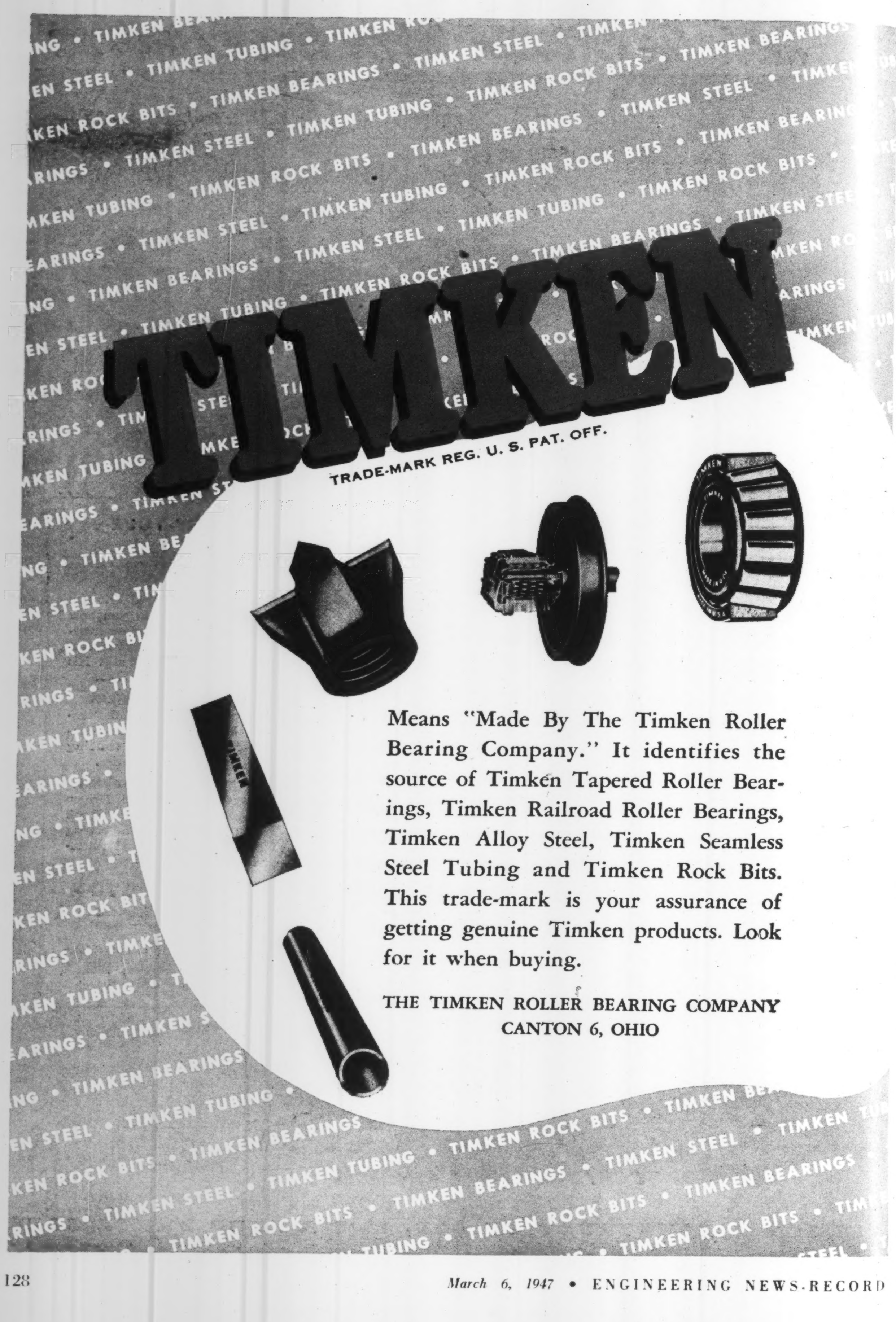
WORTHINGTON

Worthington Pump and Machinery Corporation. Worthington-Ransome Construction Equipment Division, Holyoke, Mass.

BUY BLUE BRUTES



IF IT'S A CONSTRUCTION JOB, IT'S A BLUE BRUTE JOB


TIMKEN BEARINGS • TIMKEN STEEL • TIMKEN TUBING • TIMKEN ROCK BITS
TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TIMKEN
MADE IN U.S.A.

Means "Made By The Timken Roller Bearing Company." It identifies the source of Timken Tapered Roller Bearings, Timken Railroad Roller Bearings, Timken Alloy Steel, Timken Seamless Steel Tubing and Timken Rock Bits. This trade-mark is your assurance of getting genuine Timken products. Look for it when buying.

THE TIMKEN ROLLER BEARING COMPANY
CANTON 6, OHIO

the Army with the rank of lieutenant colonel, and has opened offices at 206 Library Place, Greensboro, as a consulting engineer. A graduate of the U. S. Military Academy at West Point, he later left the Army to become city engineer at Washington, N. C., and joined the municipal engineering department at Greensboro in 1922. He became director of the housing authority in 1940, later resigning to become chief engineer of Grannit, Higgins, Thompson and McDevitt, then engaged in construction at Camp Pickett, Va.

O'Kelly Myers, formerly senior division engineer with the Board of Water Supply of New York City, is now resident manager for Buck, Seifert and Jost, consulting engineers, in Guayaquil, Ecuador, where he is engaged on investigations for a new water works system. Mr. Myers for many years was on the staff of the late Nicholas S. Hill, Jr., consulting engineer on various water supply and sewerage projects and subsequently as senior division engineer on the construction of the Delaware Aqueduct for the City of New York. During the war, he was engaged on studies and design of a water supply system as chief engineer for Pleasantville Constructors, Inc. He was also engaged on studies made for available hydroelectric power from streams in northern New York, the St. Lawrence River and Delaware River, as well as the Hiwassee River in North Carolina.

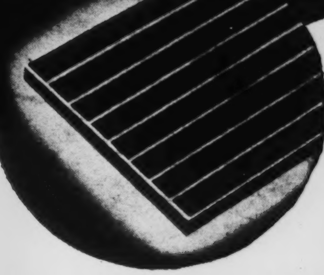
A. C. Eddy, 69, chief engineer of way and structures for the British Columbia Electric Co. has retired after 34 years' service. He went to the northwest in the nineties to help build the Great Northern Railroad's lines between Seattle and the Canadian border.

H. Arthur Hook, formerly a civil engineer with the U. S. Corps of Engineers, has been appointed assistant administrator of airports for the Civil Aeronautics Administration, to succeed Charles B. Donaldson. The CAA is embarking on a $500,000,000 federal aid airport program.

Harold A. Hollstein has been elected to the newly-created post of executive vice-president of The Austin Co.; and L. E. Coonly, vice-president and general manager of sales; and Harold A. Anderson, vice-president and eastern district manager, both civil engineers, have been elected directors.

Alfred Laufer and **Samuel C. Zinman** have organized the Bell Construction Co., Inc., engineers and builders, with offices at 601 West 26th St., New York 1, N. Y.

TRUE AND STRAIGHT PAVING ALIGNMENT

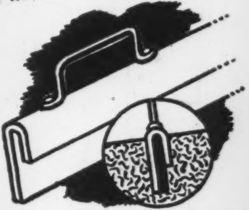


with Keystone

Asphalt Mastic Board DUMMY JOINT

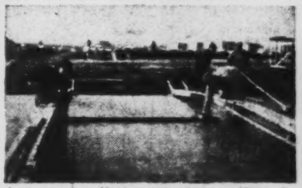
A revolutionary type of paving joint for transverse or longitudinal installation where economy dictates "weakened plane" type contraction joints. Maximum rigidity obtained without expensive installing machinery.

Keystone dummy joints can be used transversally or longitudinally. Designed to give maximum rigidity, are absolutely waterproof, are low in cost and easy to handle. Shipped in flat sheets at job specified lengths, sheets are scored at specified widths and are simply broken off when needed.

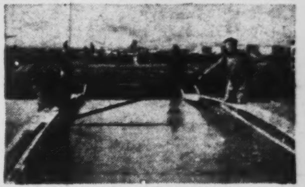


Dummy Joint Installing Channel—This 12 gauge steel "U" shaped strip simplifies and speeds the installation of Keystone Dummy Joint. Made in lengths to match the joint and just wide enough to receive the joint and still withdraw freely.

Dummy Strip is easily broken off and carried out on bridge over wet cement for installation.



Accurate alignment is easily obtained when joint and installing channel are pressed into cement.



Steel installing channel is withdrawn leaving joint imbedded in concrete. Process is repeated.

Ask about the
NEW KEYSTONE EQUIPMENT LINE

KEYSTONE offers contractors a joint slitting machine, concrete curing compound spray machines and rubber asphalt joint sealing compound kettles at accepted manufacturer's prices. Write or wire.

KAP

KEYSTONE ASPHALT PRODUCTS COMPANY

A Division of the American-Marietta Company
43 E. OHIO STREET, CHICAGO 11, ILLINOIS

a practical way to solve
YOUR HOUSING PROBLEM

THE NEW 1947
Shoreland Tandem
AMERICA'S NO. 1 TRAILER COACH BUY!

ALL THE COMFORTS OF
A BEAUTIFUL HOME

• Shoreland Tandem Trailer Coaches can help you lick the housing problem by providing highly satisfactory homes and sleeping quarters for your men. Shoreland Tandems are skillfully planned, ingeniously laid out and beautifully furnished with all modern appointments. It represents America's best value in trailer coaches and an excellent investment. It will pay you to investigate the possibilities the Shoreland Tandem offers you. *We suggest you write us for our full color, 8-page Illustrated Folder.*

TCMA

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DEPT E N W CORNER 37TH STREET AT PRINCETON · CHICAGO 9 ILL

DREDGES
HYDRAULIC
• DIPPER •
CLAMSHELL
Bolted sectional steel hulls for landlocked, inland waters
If you need a dredge, write us!
AMERICAN STEEL DREDGE CO. INC.
FORT WAYNE 1 · INDIANA · U.S.A.
DESIGNERS AND BUILDERS OF DREDGING EQUIPMENT SINCE 1905

DRILLING CONTRACTORS
DIAMOND AND SHOT CORE BORINGS — DRY SAMPLE BORINGS
Foundation Testing for Bridges, Dams and All Heavy Structures
Also
Manufacturers of Diamond and Shot Core Drills, Accessories and Equipment
SPRAGUE & HENWOOD, Inc.
Scranton, Pa. Dept. E, U. S. A.

Elections and Activities

Charles Thorn, Vancouver, B. C., building contractor, has been elected president of the B. C. Building Contractors' Association. Charles Wilson, Nanaimo, is vice-president.

The Illinois Association of Highway Engineers, has elected the following officers: R. A. Lonier, Chicago, chairman; R. T. Leslie, Springfield, vice chairman; R. J. Kenyon, Elgin, secretary; W. M. Waller, Paris, treasurer. Earl M. Guy, Springfield, was named director to the Illinois Engineering Council.

The Building Contractors of Terre Haute, Ind., has been organized with Louis Roehm, Jr., as president. Other officers are Robert Meyer, vice-president; Richard Garmong, secretary-treasurer, and John D. Ennis, program chairman. Offices have been established at 533 Opera House Block, with James H. Adamson as executive secretary. Six standing committees to negotiate wage contracts with labor unions employed by contractors were named. Chairmen are: Masonry, R. J. Watson; lathing and plastering, Henry Libbert; cement finishers, W. L. White; painters, Karl Kalin; teamsters, Jess Dennis, and iron workers, W. J. Cleary. Fifty-one general contractors and sub-contractors attended the organization meeting.

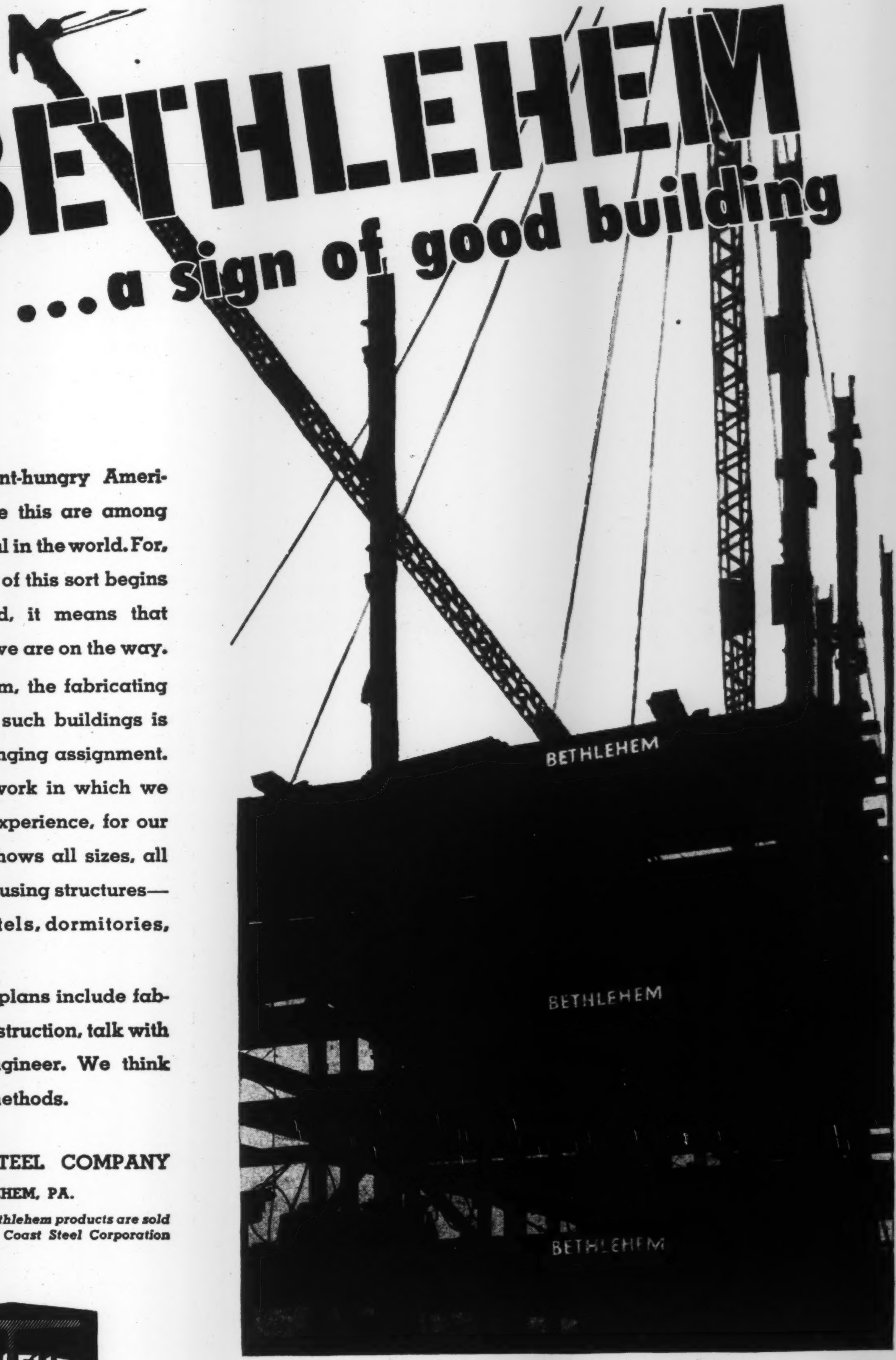
The following have been elected officers of the Associated Pennsylvania Constructors for the year 1947: W. C. M. Butler, President, Central Pa. Quarry, Stripping & Const. Co., Hazleton; Herman Riebe, Vice-President, Charles Riebe, Lansford; A. E. O'Brien, Executive Secretary, Harrisburg; S. Howard Brown, Treasurer, Brown, Davis and White, Grantville and Edward A. Daylor, Chairman, executive committee, Coatesville.

Burton C. Smith has been elected president of the Home Builders Association of the Mahoning Valley, Youngstown, Ohio, with Harry Garde named vice-president; Jack Heath, secretary; and F. E. Anderson, treasurer.

James J. Murff of Calhoun City, Tenn., has been elected president of the student chapter of the American Society of Civil Engineers at Duke University, Durham, N. C. Gordon L. Smith of Chattanooga, Tenn., has been elected vice-president; and Wally McMahon of

BETHLEHEM

...a sign of good building



To apartment-hungry Americans, scenes like this are among the most beautiful in the world. For, when a skeleton of this sort begins to rear skyward, it means that more places to live are on the way.

To Bethlehem, the fabricating and erecting of such buildings is always a challenging assignment. It is a kind of work in which we have had rich experience, for our album of jobs shows all sizes, all types of mass-housing structures—apartments, hotels, dormitories, and others.

When your plans include fabricated steel construction, talk with a Bethlehem engineer. We think you'll like our methods.

BETHLEHEM STEEL COMPANY
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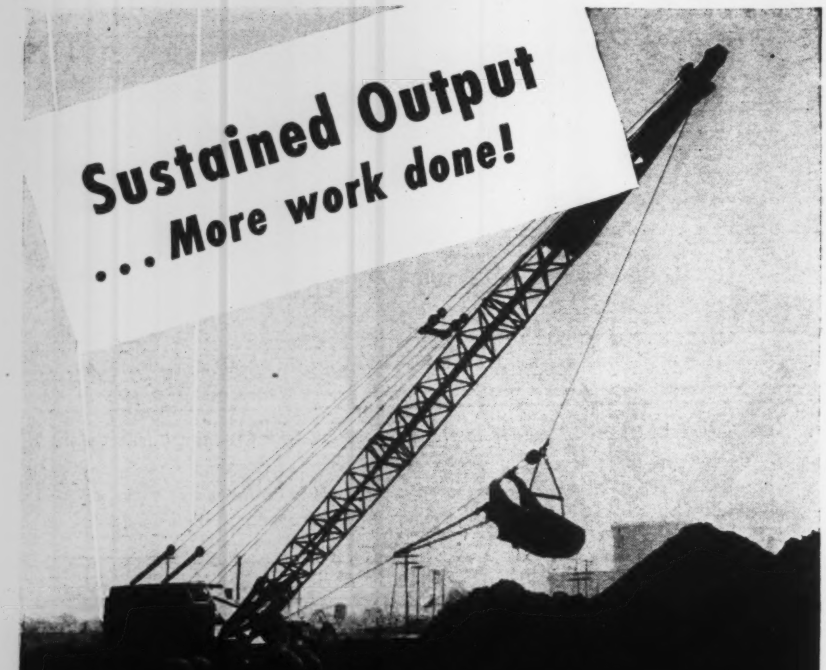
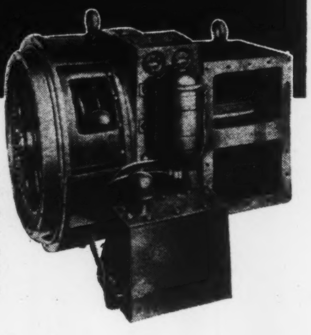
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

★ BETHLEHEM STEEL ★

FABRICATED STEEL CONSTRUCTION



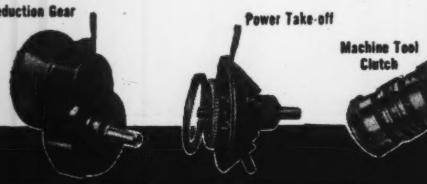


This Manitowoc Model 3000-A Speedcrane of 40-ton capacity is equipped with a Twin Disc Hydraulic Torque Converter. Designed for great stability, this unit, equipped with the Torque Converter, offers smoothly controlled operation when handling heavy lifts at long radii.

You'll get *more* work per unit of time from your equipment with a Twin Disc Hydraulic Torque Converter transmitting the power. On a crane, hoist or dragline, the Torque Converter assures sustained output . . . eliminates the need for selecting the right gear for a given set of conditions.

The flexibility of the Torque Converter makes it possible for the operator to hold his load motionless in mid-air merely by throttling his engine to supply just enough torque to balance gravity. He can ease the load gently and accurately up or down with the throttle . . . there's no time lost from "bobbing" of the load.

Write the Twin Disc Clutch Company at Racine, Wisconsin, for Bulletin 135A, which gives full information about the Twin Disc Hydraulic Torque Converter. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).



TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

St. Petersburg, Fla., secretary-treasurer.

W. G. Brown of Durham, N. C., has been named chairman of a committee to direct the 1947 annual state training school for waterworks operators at N. C. State College, Raleigh, in June. Others on the committee are C. M. Abbitt of Roxboro, W. S. McKimmon of Raleigh, E. M. Johnson of Raleigh, P. D. Davis of Durham and R. E. Stiemke of Raleigh. The school is directed by the N. C. Water Works Operators' association in cooperation with the N. C. section of the American Waterworks Association. The state board of health and the league of municipalities cooperate in providing for the training, and the Extension Division of the N. C. State College makes its facilities available.

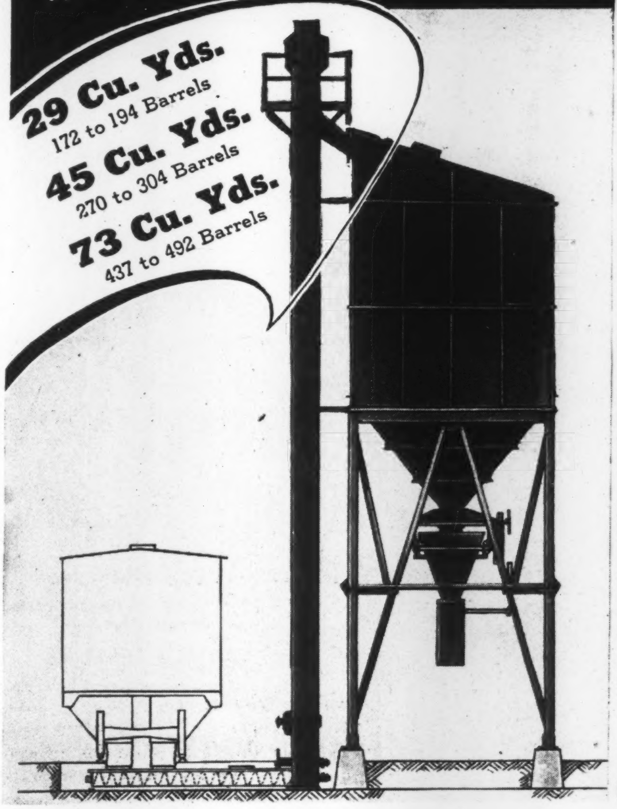
Officers re-elected by the 497th Engineers' Association, Peoria, Ill., were: president, Emmerson R. Rapp; vice-president, Harold McGovern; corresponding secretary, John Scanlon. Others: secretary, Joe Gaffney; treasurer, Ray J. Wilkey; assistant secretary, John J. Maher; directors, Dalton Jones, James Barrett, Ralph Black, Robert Robbins and Wallace Favorite. The association consists of former members of a heavy equipment maintenance outfit recruited from the Caterpillar Co. They organized during service at Kanchapara, India, in 1944.

The Engineers Club, South Bend, Ind., has opened its new club rooms to serve as the focal point for all engineering meetings and activities in northern Indiana and southern Michigan.

F. Elgin Bayless, chairman of the Florida State Road Department and vice-president of the Southeastern Association of State Highway Officials, has been elevated to the presidency of the association following the resignation of President George T. McDonald, retiring engineer-director of the Georgia Highway Department. Mr. McDonald expects to enter the engineering and construction business in Dalton, Ga. Col. M. E. Cox, engineer of the Georgia Highway Department, resigned as secretary of the association and Mr. Bayless has appointed Robert J. McClure to succeed him.

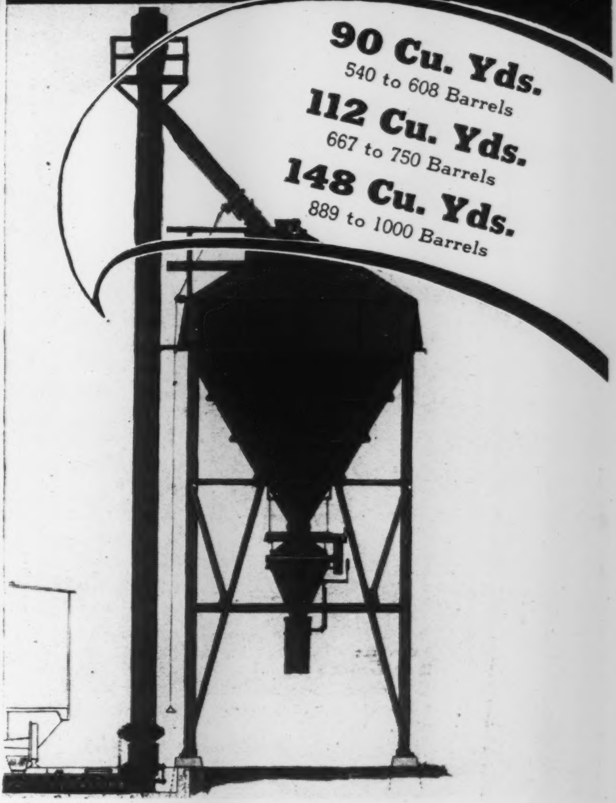
Toledo section, American Society of Civil Engineers, has elected Robert Brown, of A. Bentley & Sons Co., as president, succeeding Carleton S. Finkbeiner, of Finkbeiner, Pettis & Strout. Samuel C. McKee, Lucas County sanitary engineer, was elected first vice-president; Harvey Jones, of Jones & Henry, was named second vice-president; and Clair Shaler, of Finkbeiner,

ERIE *Portable*
CEMENT PLANTS
Type "M" 3 Standard Sizes


29 Cu. Yds.
172 to 194 Barrels
45 Cu. Yds.
270 to 304 Barrels
73 Cu. Yds.
437 to 492 Barrels

Type "M," a complete single compartment bulk cement storage and batching plant designed for easy portability. Made with 2 or 3 sections. This efficient, low cost plant eliminates all the inconvenience and waste from handling bag cement. A selection of weighing Cemeters provides accurate batching of cement to batch trucks and truck mixers. Write for Bulletin M.

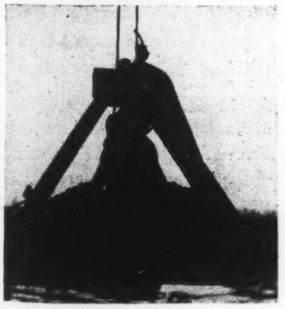
ERIE *Semi-Portable*
CEMENT PLANTS
Type "L" 3 Standard Sizes


90 Cu. Yds.
540 to 608 Barrels
112 Cu. Yds.
667 to 750 Barrels
148 Cu. Yds.
889 to 1000 Barrels

Type "L" Cement Plants, semi-portable, knocked down type made in large bolted sections for fast field erection. Available in one or two compartments, each with a choice of 4 weighing Cemeters to provide accurate batching of bulk cement into batch trucks or truck mixers. 30 Ton per hour bucket elevator fed by undertrack screw from hopper bottom cars. Write for Bulletin L.

ERIE STEEL CONSTRUCTION COMPANY
173 GEIST ROAD ERIE, PA., U. S. A.

GENERAL PURPOSE CLAMSHELLS



One of 10 Erie types of buckets available in 11 standard sizes from 1/4 to 2½ Cu. Yard, incorporating the block and tackle plus leverage principles with selective reeving for speed and power. Steel castings and forgings with welded steel plate construction are combined in a low-head design for greatest digging durability. Write for booklet on general purpose buckets.

PORTABLE CONCRETE PLANTS

Erie combines on an 8 rubber tired chassis, a complete concrete making plant. It includes 20 cu. yd., 3 part storage bin, vertical bucket elevator, Weighing Aggre-Meter with extra beam for measuring water. All bin gates are hydraulically operated by fingertip action. Make concrete where you use it. Write for new booklet.

THE CLINTON
Every Day
THE DEMAND GROWS...
For The
CLINTON ENGINE

PRECISION BUILT

That's why the Clinton is in demand by users, dealers and manufacturers employing compact air-cooled power—Built by master craftsmen employing the most modern tools and equipment, the Clinton has set a new standard for performance—The Clinton enjoys an enviable reputation for economy of operation, longer service and staying power—SHOWN IS THE GEAR REDUCTION MODEL BUILT FOR EQUIPMENT REQUIRING SLOW DRIVING SPEEDS—THREE RATIOS AVAILABLE: 6 to 1—4 to 1—2 to 1 AS REQUIRED.

WORLD'S LARGEST MANUFACTURER SPECIALIZING IN 1 TO 2 HP ENGINES

SALES AND SERVICE THROUGHOUT THE WORLD

See Your Dealer for New Low Price

CLINTON MACHINE CO.
CLINTON, MICHIGAN
Dept. 100 ER

Pettis & Strout, was elected secretary-treasurer.

The recently organized Engineers' Council at Buffalo, N. Y., will be known hereafter as the Technical Societies Council of the Niagara Frontier, the group announced. An outgrowth of the War Production Conferences sponsored by the engineering societies of Western New York, the council has changed its name to indicate better its representation of 21 societies.

Its purpose is to further the public welfare wherever technical and engineering knowledge and experience is involved; to promote co-operation among technical societies of the Niagara Frontier, and to consider and act upon matters of mutual concern to the engineering and allied technical professions.

The council will arrange inter-society meeting with speakers of national prominence and will publish Engineering News, a bulletin originated by the Buffalo Section of the American Society of Mechanical Engineers. Officers of the council are: President, George W. Gleasner; vice-president, Edward J. Nunan; treasurer, Carlos E. Harrington; secretary, Earl W. Fowler.

The Milwaukee chapter of the Associated General Contractors of America, has elected the following directors:—W. H. Emory, Jr., William F. Kachel, John H. Dohlman, T. L. Cottam and Arthur A. Ornst.

The Northeastern Section, American Society of Civil Engineers, has elected Prof. Emil Gramstorf, Northeastern University, president; Miles Clair, member of the Boston consulting engineering firm, Thompson & Lichtner Co., vice-president, and Prof. Earle F. Littleton, Tufts College, secretary and treasurer.

B. A. Johnston of Winnipeg has been elected president of Manitoba Association of Professional Engineers. Other officers elected were A. H. Rogers, vice president, C. S. Landon, secretary and registrar, J. W. Battershill (retiring president), George E. Cole, C. L. Fisher and T. E. Storey, counsellors.

George H. Atkinson of the Guy F. Atkinson Co., San Francisco, has been elected president of the Northern California Chapter, Associated General Contractors, Al Biasotti, of Louis Biasotti & Son, Stockton, was named vice-president, and H. Earl Parker, of H. E. Parker, Marysville, treasurer. Winfield H. Arata, secretary-manager, and Florence Smith, assistant secretary, were reappointed.

Tom Priddy, Van Wert Ohio County

FORMULA No. 640
a clear liquid waterproofing for old or new construction

PENETRATES
deeply—one inch or more—is not a surface treatment. Brush, spray, or float on stone, cast stone, concrete, mortar, stucco, tile, brick, plaster, wood, wall board — any absorbent material.

WATERPROOFS,
preserves, prevents dusting of floors, surface dirt washes away in rain.

FORMULA NO. 640
is a balanced formula of seven different waxes and resins in a hydrocarbon solvent.

ACID-ALKALI proof
does not oxidize, unchanged by temperature.

PERMANENCE
it is our opinion it will last as long as the concrete, mortar, stucco, etc. lasts.

OIL PAINT
saponifies on cement unless sealed first with Formula No. 640.

APPLY to either side:
The pressure side, or opposite side —it is equally effective.

HYDROSTATIC PRESSURE
a 20 foot head has been held by Formula No. 640.

CUTS WATERPROOFING COSTS
because it applies three times as fast as paint, requires no special technique.
No preparation — comes ready to apply.
Eliminates necessity of furring.
Concrete floors and walls need no membraning.

Keeps in all climates
Harmless to use
Good coverage
Moderate price

Write our Engineering Department for office test kit, technical data, or regarding any special problem.
J. Wilbur Haynes, Engineer

OTHER PRODUCTS: Formula No. 640 Toxic, combines waterproofing with termite and fungus protection; cement hardener; floor mastic; roof coatings, etc.

HAYNES PRODUCTS CO.
4007 Farnam St.
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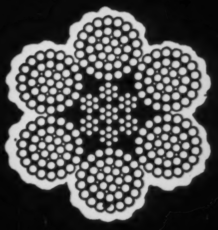
For Strength plus Flexibility



UPSON-WALTON
6 x 37 LAYRITE WIRE ROPE

FOR overhead traveling cranes in steel mills, for winch lines and slings, for holding and closing lines on grab buckets, for towing hawsers and mining machine ropes—industry after industry has conditions where high strength must be combined with great flexibility.

Wherever drum or sheave diameters are small, or where reverse or acute bends are encountered, fatigue stresses are high. For this type of service Upson-Walton 6 x 37 Perfection Layrite Cable is best because the individual wires in the strand are finer; therefore they are more flexible and better able to resist fatigue stresses. In addition, the greater number of fine wires in the rope gives it a greater metallic area, so strength is still high.

Hemp center or, where crushing conditions are extremely severe, IWRC (independent wire rope center).

Specify Upson-Walton 6 x 37 when you need maximum flexibility plus a high degree of strength.

Specify Perfection grade because this improved plow steel is the strongest and toughest and most resistant to wear of all the grades of wire used to make rope.

Specify Layrite because this fine *pre*formed wire rope results in longer life, greater safety and greater economy.

Upson-Walton 6 x 37 Perfection Layrite is worth specifying,
and always up to specifications!

Established 1871

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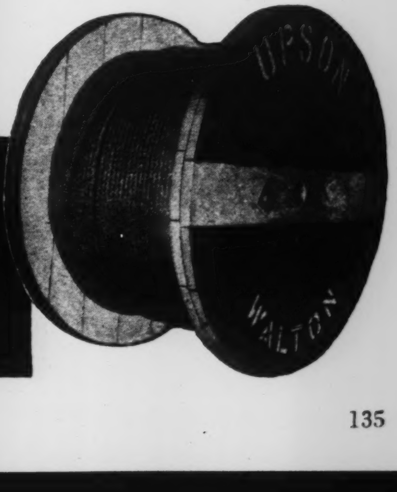


THE UPSON-WALTON COMPANY

Manufacturers of Wire Rope, Wire Rope Fittings, Tackle Blocks

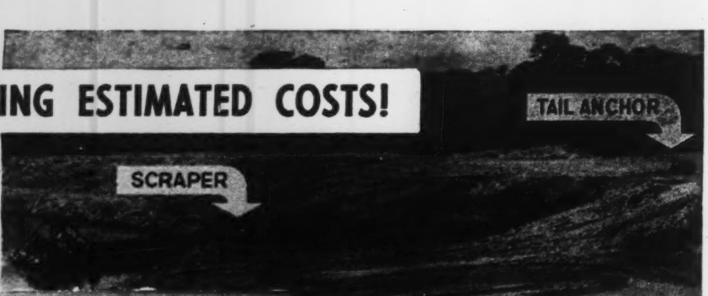
MAIN OFFICES AND FACTORY: CLEVELAND 13, OHIO

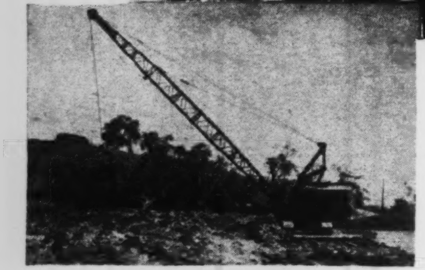
114 Broad Street
New York 4

737 W. Van Buren Street
Chicago 7

241 Oliver Building
Pittsburgh 22

CUTTING ESTIMATED COSTS!





Adaptability of Sauerman Long Range Scraper Equipment in reducing estimated costs is illustrated by various ingenious methods used in difficult dredging operation by C. A. Pitts, Ltd., outstanding Canadian contractor, at DeCew Falls plant of Ontario Hydro-Electric Power Commission. Above is a Sauerman Scraper unloading dirt from barge and filling low spots along banks of DeCew Falls tailrace. View at left on same job shows another Sauerman Scraper making a fill with material dredged from tailrace by revolving dragline.

SAUERMAN LONG RANGE MACHINES

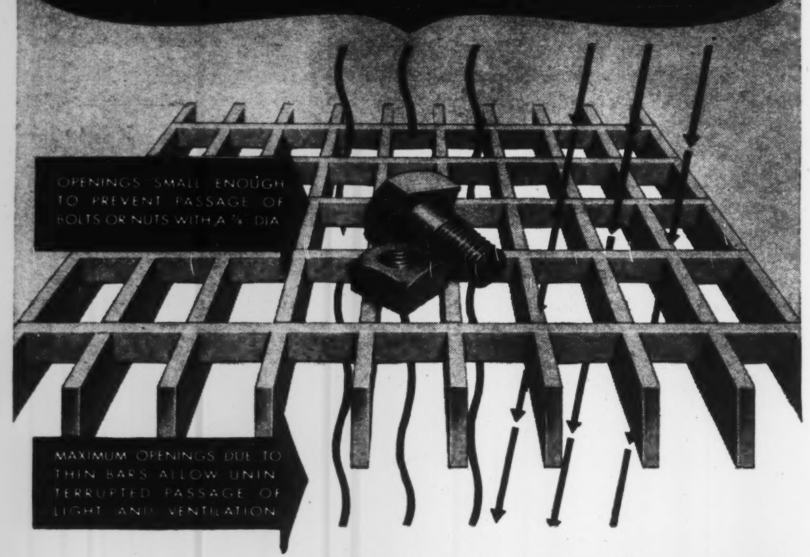
On excavating and dredging jobs with irregular terrain and diverse conditions you will find the versatility of SAUERMAN Scraper Machines an important factor in making savings over previously estimated costs. All over the world thousands of contractors have proven to their own satisfaction that SAUERMAN Scrapers and Cableways simplify many jobs that would be complicated and costly by any other method. Initial cost is low. Small power consumption. Simple upkeep.

Write today for illustrated catalog.

Crescent Scraper
Only Sauerman Machines offer this unique dragline bucket.

SAUERMAN BROS., INC.
532 S. CLINTON ST. CHICAGO 7, ILL.

This is TRI-LOK
OPEN STEEL FLOORING


OPENINGS SMALL ENOUGH TO PREVENT PASSAGE OF BOLTS OR NUTS WITH A ⅜" DIA
MAXIMUM OPENINGS DUE TO THIN BARS ALLOW UNINTERRUPTED PASSAGE OF LIGHT AND VENTILATION

Extra strong construction — openings closely spaced — available in rectangular, diagonal and U shapes — with Safety Steps. Ask for Bulletin 1140.

DRAVO CORPORATION, NATIONAL DEPARTMENT
300 PENN AVENUE, PITTSBURGH 22, PA.
(*Distributor for THE TRI-LOK COMPANY*)

DRAVO

engineer, has been elected president of the Northwestern Ohio Drainage Association with Dan Gross, Bowling Green, former Wood County commissioner, as first vice-president; Melvin H. Rice, Lucas County engineer, Toledo, as second vice-president; and W. A. Findlay Hogle, deputy Hancock County engineer, secretary-treasurer.

At the recent annual meeting of the Association of Professional Engineers of New Brunswick, J. F. T. Morrison, of Campbellton, was elected to the presidency; R. M. Richardson, of St. John, vice-president; W. C. MacDonald, of Moncton, L. G. Lilley, of St. John, H. Moore, of Fredericton, councillors.

A discussion on "What is Holding up the Highway Program?" at the convention of the Associated General Contractors of Missouri in Kansas City, recently lent renewed emphasis to the fact that Missouri highway officials are trying to stretch their dollars as far as possible in face of prices which are considerably higher than prewar.

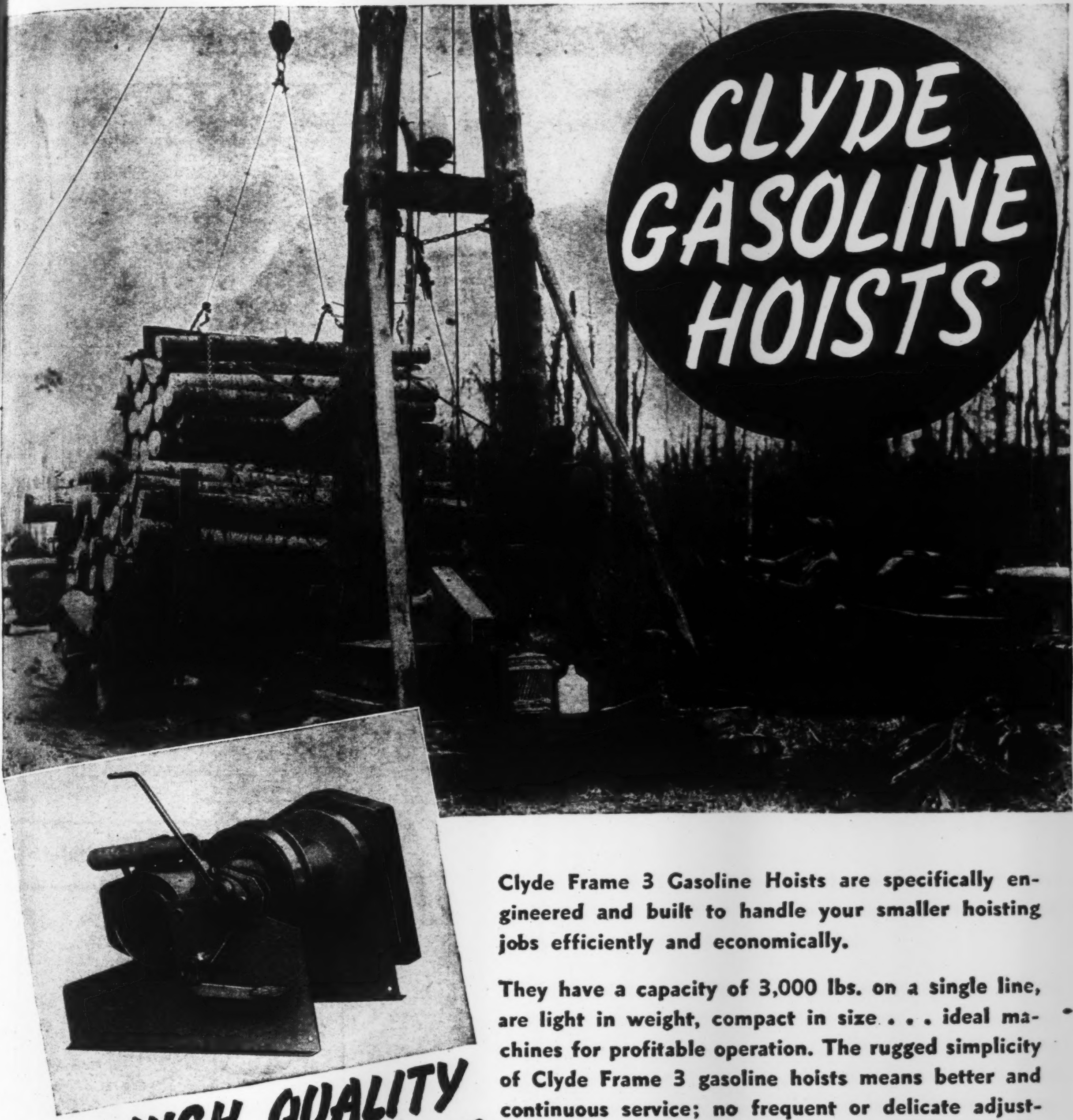
Contractors contended that certain types of highway construction can be built at no great increase in cost over 1940 and that, by keeping in close touch with the material situation, the highway department could pick jobs which are needed and which could be constructed economically.

Moderator was Col. W. E. Potter, district engineer, Corps of Engineers, Kansas City, Mo. The discussion panel comprised Paul C. Jones, chairman of the Missouri State Highway Commission; C. W. Brown, chief engineer, Missouri State Highway Department; S. W. O'Brien, district engineer, Public Roads Administration; A. R. Waters, president of Carter-Waters Corp., a material supplier; and F. E. Rolfe, secretary-treasurer of Harrison Engineering & Construction Corp., representing the contractors.

Officers elected are: president, E. W. Menefee, president of W. J. Menefee Construction Co., Sedalia, Mo.; vice-president, Alexander Maitland, president of Kansas City Bridge Co., Kansas City, Mo.; treasurer, J. M. Joyce, vice-president of Cameron, Joyce & Co., Keokuk, Iowa; and secretary, E. C. L. Wagner, Jefferson City, Mo. Mr. Joyce was elected treasurer for the eighth consecutive time.

The Portland, Ore., post of the Society of American Military Engineers has installed Col. Theron D. Weaver, North Pacific Division Engineer, Corps of Engineers, as its new president. Other officers are J. Donald Kroeker, vice president; Gordon H. Fernald Jr., secretary; Andrew J. Brugger, treasurer, and L. E. Knerr, director.

CLYDE GASOLINE HOISTS



✱ HIGH QUALITY
✱ LIGHT WEIGHT
✱ LOW COST

Clyde Frame 3 Gasoline Hoists are specifically engineered and built to handle your smaller hoisting jobs efficiently and economically.

They have a capacity of 3,000 lbs. on a single line, are light in weight, compact in size . . . ideal machines for profitable operation. The rugged simplicity of Clyde Frame 3 gasoline hoists means better and continuous service; no frequent or delicate adjustments required to maintain full hoist efficiency. For real hoisting value you can't beat this new little Clyde.

Write for descriptive circular on Clyde Frame 3 hoists. One or two drum sizes available.

HOISTS . . . DERRICKS . . . WHIRLEYS . . . CAR PULLERS . . . HAND POWERS
BUILDERS TOWERS . . . DECK MACHINERY . . . TANDEM ROLLERS . . . LOGGING EQUIP.

CLYDE

Manufactured by

CLYDE IRON WORKS, Inc.

Duluth 1, Minnesota

WICKWIRE ROPE
sizes and constructions for every need

Specific tasks call for specific types of wire rope . . . but, regardless of construction, it must be tough and dependable.

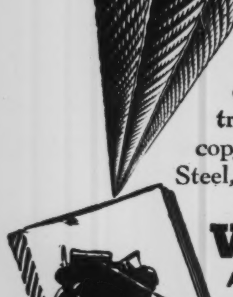
That's why more and more men are relying on the stout steel muscles of Wickwire Rope.

Back of the durability and dependable performance of Wickwire Rope lies 126 years of specialization in the manufacture of wire and wire products. Every step—from ore to finished product—is handled in our own plants. Only the sound heart of the steel ingot is used for Wickwire Rope and every wire is drawn until it is accurate within a fraction of a thousandth of an inch.

Wickwire Rope is available in all sizes and constructions, both regular lay and WISSCOLAY *Pre*formed.

THIS FREE BOOK SHOWS HOW TO MAKE WIRE ROPE LAST LONGER

"Know Your Ropes" contains 82 pages of suggestions on proper selection, application and usage of wire rope. This easy-to-read, profusely illustrated manual can save you money. For your free copy write Wire Rope Sales Office, Wickwire Spencer Steel, Palmer, Massachusetts.



WICKWIRE ROPE

A PRODUCT OF WICKWIRE SPENCER STEEL DIVISION OF THE COLORADO FUEL AND IRON CORPORATION

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Chicago • Denver • Detroit • Philadelphia • Tulsa
Ft. Worth • Houston • Newport News • New York
PACIFIC COAST:—The California Wire Cloth Corp., Oakland 6, Cal.

CF&I

New Engineering Books

(*Continued from page 96*)

A. S. T. M. STANDARDS—1946: Part II, Non-Metallic Materials-Constructional. 1,762 pp. American Society for Testing Materials, 1916 Race St. Philadelphia 3, Pa. $12 (non-members).

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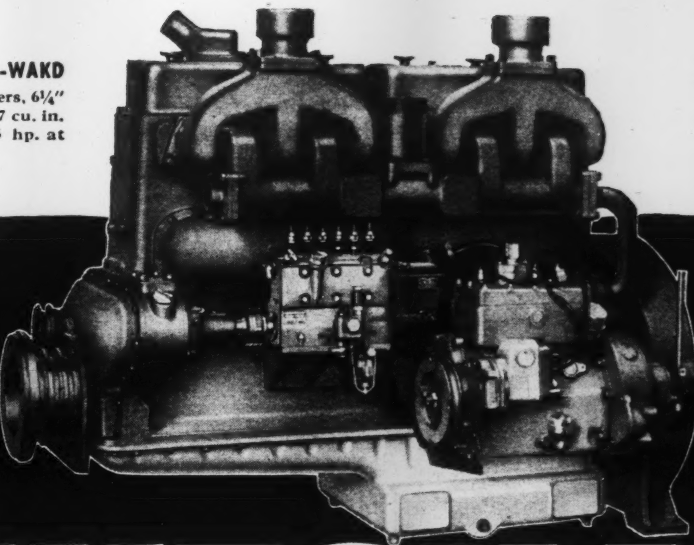

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Six cylinders, $6\frac{1}{4}''$ x $6\frac{1}{2}''$, 1197 cu. in. displ., 225 hp. at 1600 rpm.

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Diesel

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Shovels, Air Compressors, Oil Field Drilling, Off-Highway Trucking, Crawler Tractors, Logging, Saw Mills, Cotton Gins, Irrigation Pumps, Water Supply, Electric Power Generation, and Heavy Construction Machinery of all kinds.

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These modern construction and design features include: Large, seven-bearing crankshaft, with hardened crankpins and main bearings testing to 600 Brinell; vibration dampener; removable, wet-sleeve cylinders hardened to 350-400 Brinell; aluminum pistons with six rings (4 non-sticking, wedge-type; 2 straight side oil control rings, and with top ring chrome plated for long life); rifle-drilled connecting rods—I-beam section with deeply ribbed caps held by four heat-treated cap bolts; precision-type, steel-backed, heavy-duty, Diesel-design main bearings; intake and exhaust valves of chrome silicon alloy with hardened exhaust seat inserts; full pressure lubrication by outside mounted positive gear-type pump; large capacity oil cooler mounted on cylinder block; American Bosch injection pump; 24-volt electric starting system, with glow plugs, or gasoline starting engine.

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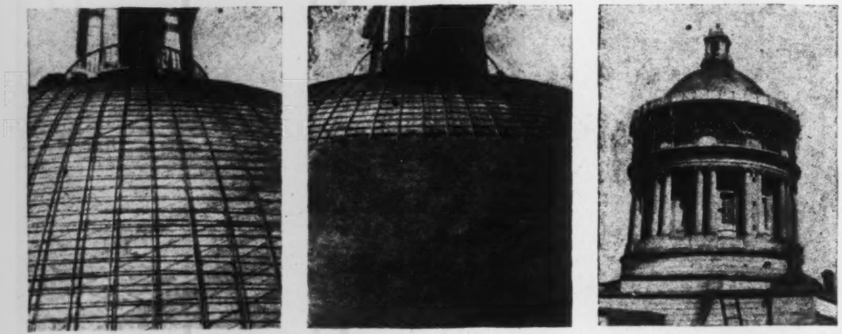

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The photos show the 48′ diameter dome of the Kentucky State Capitol at Frankfort. This dome was originally wood construction which deteriorated and necessitated replacement. The new dome was constructed of 3″ reinforced "GUNITE" by this organization.

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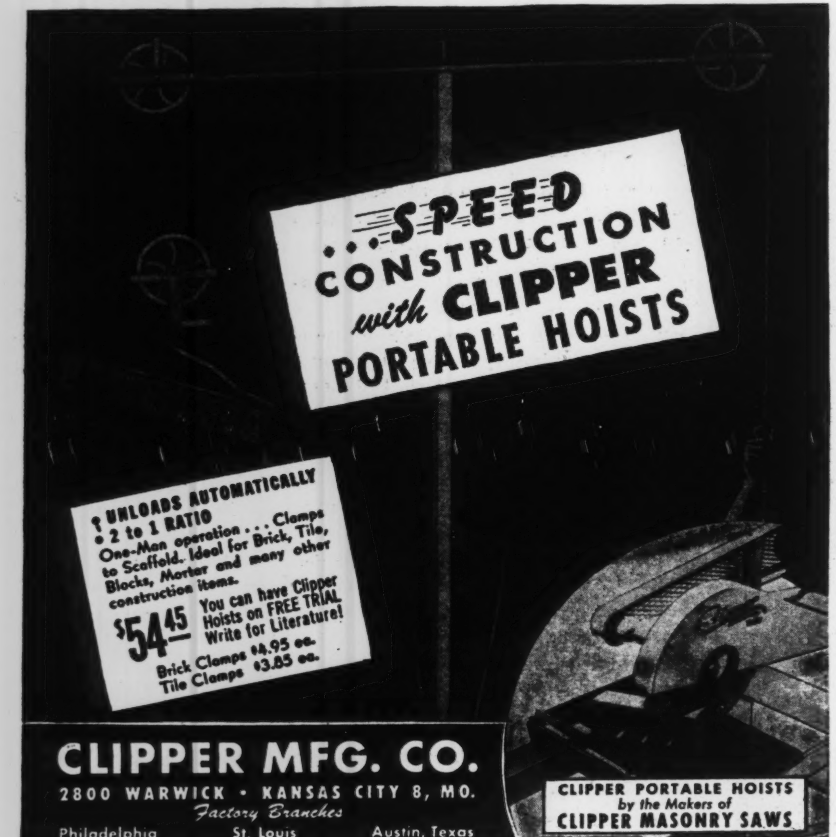

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CLIPPER PORTABLE HOISTS by the Makers of CLIPPER MASONRY SAWS

Manufacturers' Activities

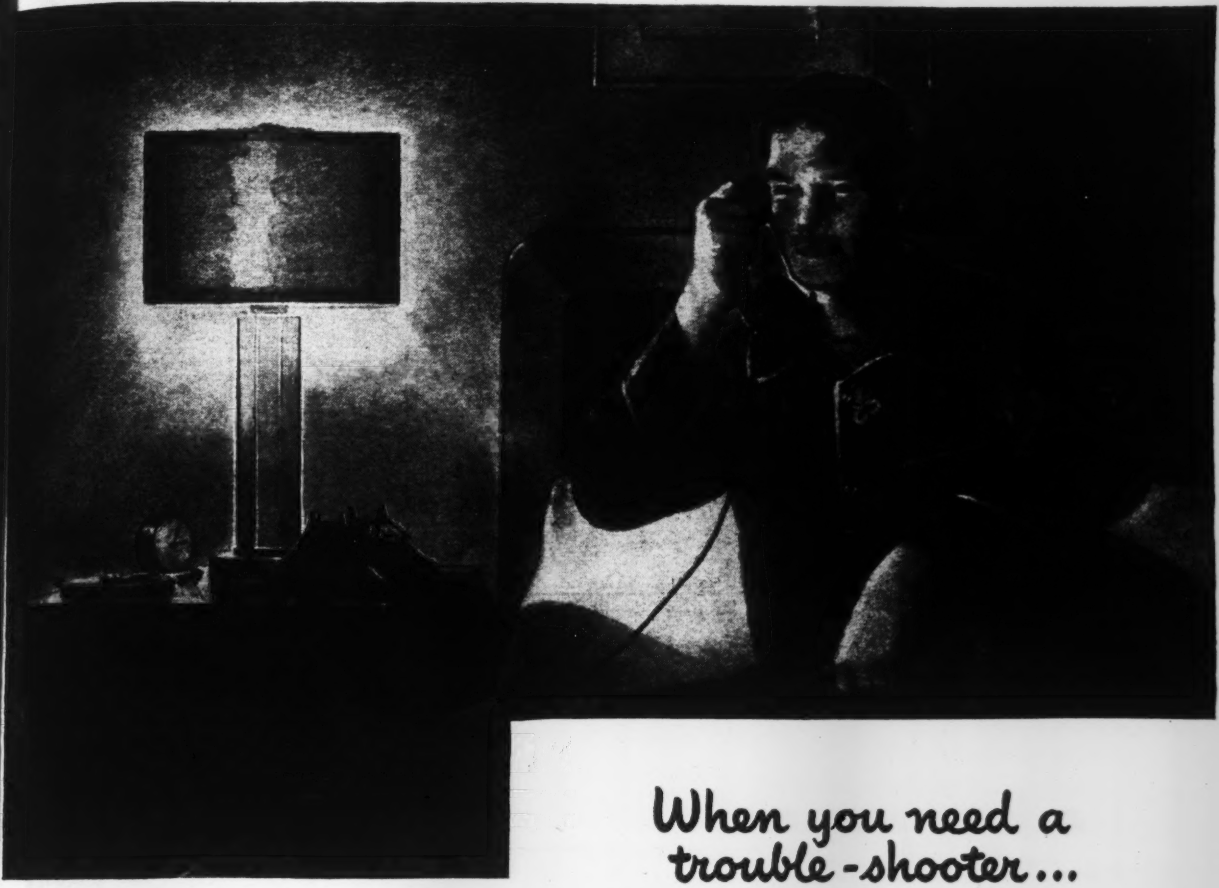
PORTABLE PRODUCTS CORP. of Pitt burgh, has opened general sales offic in the Woolworth Building, New Yor City, to correlate sales activities fo the eight divisions of the corporatio These include the Portable Safety D vision, Pittsburgh, Pa.; manufacture of safety belts, hats and the like, an American Pad & Textile Co., Greenfiel Ohio; makers of marine life jacket and outdoor equipment. John C. Sykor vice president and director of sales, i in charge of the New York office.

W. W. PAAPE, district representati in the Chicago territory, has been promoted to the position of domestic sale manager of the Euclid Road Machiner Co. He will take over his new duties o March 28 at the main offices of th company in Cleveland, Ohio. Mr. Paap has been active in the construction industry for over twenty years. E. F. Armington, former sales manager, will devote the major portion of his time to executive and management duties as secretary of the company.

HERCULES MOTOR CORP., Canton, Ohio, announces the opening of a direct factory branch on the West Coast at 2065 East 37th St., Los Angeles, Calif., to broaden its program of supplying engines, power units and replacement parts throughout the western part of the country. W. W. Cromley, vice-president in charge of West Coast operations, is in direct charge of Hercules activities west of the Rocky Mountains. He is assisted by Oliver Kelly, Herbert Wirshing, and Walter Batty, who will handle the sales activities.

Several distributors to serve Arizona, Oregon, Washington, California, Colorado, Idaho and as far north as British Columbia, Canada, have been appointed: Loggers & Contractors Machinery Co., Portland, Ore.; Diesel Motor & Equipment Co., Phoenix, Ariz.; Star Machinery Co., Seattle, Wash.; Bay Engine & Parts Co., San Francisco, Calif.; Engine Supply Co., Denver, Colo.; Sawtooth Co., Boise, Ida.; Hayes Manufacturing Co., Ltd., Vancouver, B. C.; Brown-Bevis Equipment Co., Los Angeles, Calif. and H & B Sales Co., Long Beach, Calif.

A new type office building has recently been completed at the Pittsburgh plant of **JOSEPH T. RYERSON & SON, INC.**, steel jobbers. The building is



When you need a trouble-shooter...

Call this man! He's your Equipment Supply Specialist. And he's always available to help you find the answer to your problems.

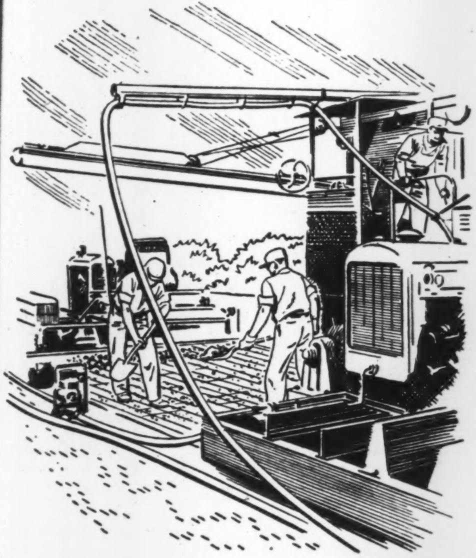
He knows, for example, how important an everyday product like water hose can be to construction operations.

That's why your Equipment Supply Specialist will recommend Monarch Road Builders' Hose for those heavy-duty uses where *extra* strength and durability are required.

You see, Monarch Road Builders' Hose is "Job-Engineered" by Hewitt to stand up under the most severe working conditions. Extra strength is assured by supporting plies of high-tensile fabric. And Monarch's thick cover is highly resistant to cutting and abrasion. Not only that, but because Monarch is light and flexible . . . your men can handle it easily and quickly.

When you need a trouble-shooter, feel free to call upon your Equipment Supply Specialist. His knowledge, experience, and ability will save you time and money.

Specify "Hewitt" . . . Phone the Hewitt distributor listed in the classified section of your telephone directory. Or write to Hewitt Rubber of Buffalo, 240 Kensington Avenue, Buffalo 5, New York.



Monarch Road Builders' Hose

HEWITT RUBBER
OF BUFFALO
Division of Hewitt-Robins Incorporated
"JOB-ENGINEERED" INDUSTRIAL HOSE • BELTING • PACKING

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..Enough to do most jobs

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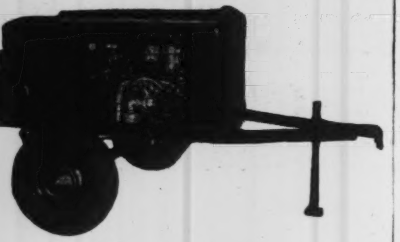
ECONOMY



The Smith Air Compressor

Why pay for needless power with oversize, expensive compressors? A lightweight Smith Compressor will do the majority of your compressor work—at less cost. Use it to run medium weight rock drills, paving breakers, clay spades, large spray guns. Capacity 60 cu. ft.—easily varied for different jobs.

Uses only 1 gal. of gas an hour. Automatic unloading and idling; self-starting. No couplings, belts, clutches or gears. Tow it at truck speeds from job to job. Ford motor and standard parts insure ready servicing anywhere.

Why not get all the facts about Smith Air Compressors? Write, phone or wire today.

GORDON Smith & CO. Incorporated

430 College St. Bowling Green, Ky.

so located with respect to plant operations, coupled with the engineered arrangement of the general offices, that order flow is streamlined to permit exceptionally fast handling. The Pittsburgh plant is located at Arch St. and Bell Ave., Carnegie, Pa.

Four distributors for GRADALL, multi-purpose earth mover of the Warner & Swasey Co., Cleveland, Ohio, have been announced: W. W. Williams Co., Columbus and Cleveland, for Ohio; Construction Equipment & Supply Co., Pittsburgh, for western Pennsylvania; Telford Equipment Co., Lansing, Mich., for Michigan; all New York state except metropolitan New York, Rupp Equipment Co., Buffalo.

Appointment of LYNN W. YOUNG as Midwest district sales representative for Sealz, highway joint sealing compound, has been announced by Samuel P. Tauber, sales agent, Naugatuck Chemical division of United States Rubber Co. Mr. Young's territory includes Texas, Oklahoma, Kansas, Nebraska, North and South Dakota, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Indiana, Michigan and Kentucky and his headquarters are at 4804 Jefferson St., Kansas City, Mo.

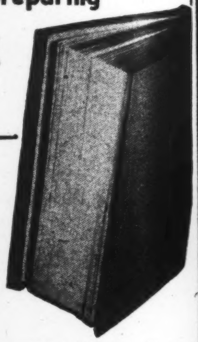
JOSEPH SAMUEL YOUNG, Allentown, Pa., president of the Lehigh Portland Cement Co., was selected chairman of the board of directors of the Portland Cement Association at its recent annual meeting in Chicago. He succeeds M. Moss Alexander of St. Louis, president of the Missouri Portland Cement Co.

MARQUETTE CEMENT MANUFACTURING Co. will open a sales office in St. Louis to serve Missouri, southern Illinois and southern Indiana. The new office will be headed by Harry C. Shields, who has been appointed sales manager for that district. Kenneth F. Hackmann has been appointed his assistant in the St. Louis sales office.

Promotion of O. W. BYNUM as manager of direct sales, John A. Gazelle as manager of distributor-dealer sales and Carl U. Spriggs as assistant general sales manager has been announced by Carrier Corp., Syracuse, N. Y. All three will make their headquarters in Syracuse. Mr. Bynum will be in charge of the sale of larger air conditioning, refrigeration and industrial heating equipment direct to customers, and will also supervise Carrier's contracting, field engineering and installation activities. Mr. Gazelle will be in charge of all distributor and dealer sales which are made through 48 distributors and 3,552 dealers throughout the United States.

Now! What you need to know about
—examining
—understanding
—preparing

Engineering Contracts



This book enables you to acquire a firm understanding of the legal details you should know for your own protection—shows you what to look for in contracts, and how to prepare them. It provides engineers and contractors with a sound, basic presentation of the legal principles applying to engineering contracts, and reduces a vast body of legal knowledge to the clearcut essentials that demonstrate the law fundamental to a whole group of cases. The book supplies a complete discussion of the current application of standard contract practice, and modern contract forms.

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NEW 4th EDITION
includes the latest legislative and legal changes—new forms of contracts—legislation on renegotiation, termination and breach.

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By JAMES IRWIN TUCKER

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The fourth edition of this highly successful legal reference book for engineers supplies you with the legal or contract theories necessary to understand and to write construction contracts. It indicates when legal advice is necessary, and provides sound, dependable answers to your questions concerning basic legal principles. It embraces the principles of law most important in engineering and business affairs, covers contract essentials, types of engineering contracts, construction or interpretation of contracts, etc.

This list of chapter headings indicates the broad area of legal principles covered:

1. **Business of Contracting**
2. **Contract Essentials**
3. **Development of Contract Principles**
4. **Agency, Tort and Independent Contractor**
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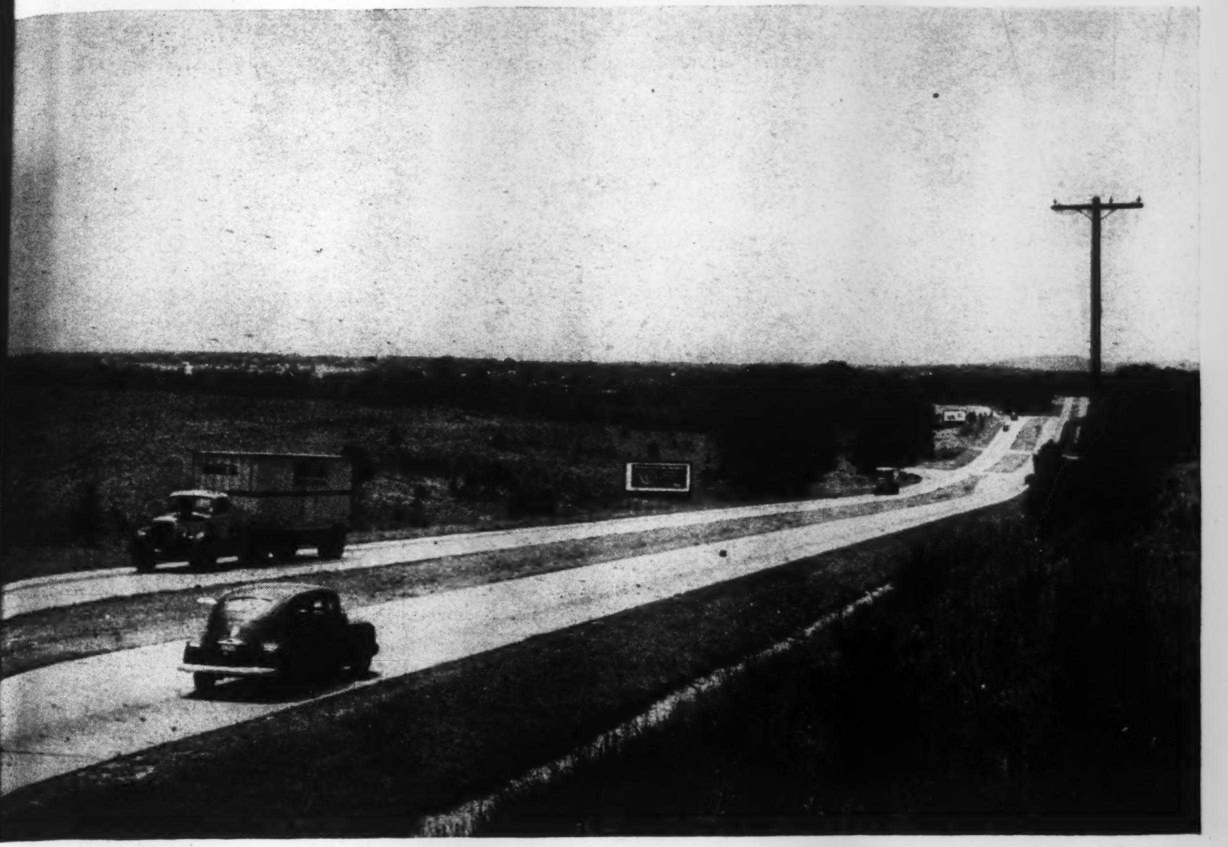

View on South Carolina's divided, four-lane concrete highway about midway between Greenville and Spartanburg. Road carries about 4,500 vehicles each day.

South's Longest Divided, Four-Lane Highway is *CONCRETE*

THE concrete-paved, four-lane, divided highway, which runs 27½ miles between Greenville and Spartanburg in South Carolina, is the South's longest divided-lane road. It provides a safe, fast and convenient route for the heavy bus, truck and passenger car traffic between these two industrial cities.

The project, completed in 1945, utilizes for one traffic lane, nearly ten miles of concrete pavement built 17 to 21 years ago.

The long life of concrete has been demonstrated all over the country. Of more than 100,000 miles of concrete pavement built on state rural primary highway systems since 1910, approximately 80 per cent of it was still in service at the beginning of 1946.

Send for free copy of new book, "Concrete Pavement Design," for roads and streets carrying all classes of traffic. Distributed only in United States and Canada.

Whether for rural highways, urban expressways or residential streets, concrete pavement gives long years of service at *low annual cost*—the true measure of pavement economy.

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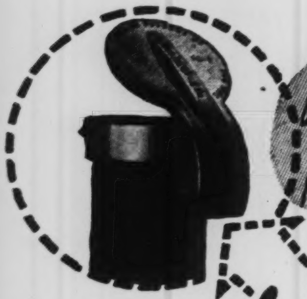
DEPT. A3a-17, 33 W. GRAND AVE., CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work



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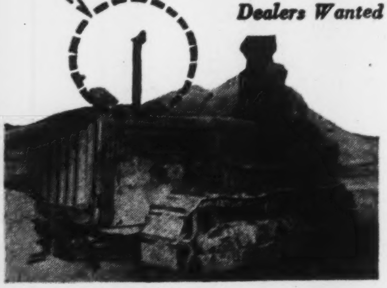

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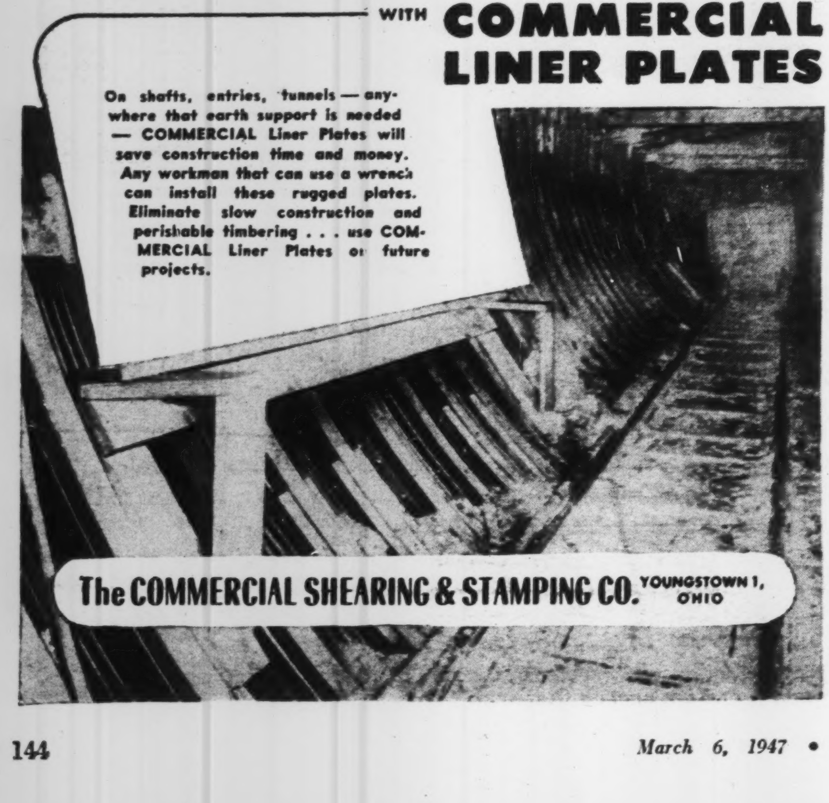

On shafts, entries, tunnels — anywhere that earth support is needed — COMMERCIAL Liner Plates will save construction time and money. Any workman that can use a wrench can install these rugged plates. Eliminate slow construction and perishable timbering . . . use COMMERCIAL Liner Plates on future projects.

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Manufacturers' Publications

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Mechanical Packings — (20-p. catalog) Contains information on service applications as well as construction and performance features of the most widely-used Paimetto packings. These include self-lubricating, molded, sheet, and other special purpose types. It also contains application chart. — *Greene, Tweed & Co., North Wales, Pa.*

Power — (32-p. bulletin) Presents equipment available for power generation and distribution, ranging from steam and hydraulic turbines, turbo generators, engine type generators and condensers and auxiliaries to pumps, water conditioning, motors, motor control, switchgear, circuit breakers, power and distribution transformers and unit substation. — *Allis-Chalmers Mfg. Co.,* 708, *Milwaukee* 1, *Wis.*

Portable Lighting and Power Units—(4-p. booklet) Contains complete specifications for floodlight, searchlight, combination and beacon models.—*Davey Compressor Co., Kent, Ohio.*

Soil Stabilizer—(Illustrated bulletin) Describes new single pass soil stabilizer, designed to make use of on-the-spot materials in building subgrades, secondary roads, airports, etc. — *Harnischfeger Corp., Milwaukee* 14, *Wis.*

A. C. Welders—(Illustrated booklet) Contains construction details, electrical specifications and application data on complete line of A.C. transformer type welders. Electrical specifications and performance data are presented in chart form. General application information concerning recommended electrodes is also included. — *Westinghouse Electric Co., P. O. Box* 868, *Pittsburgh* 30, *Pa.*

Earthmoving—(12-p. folder) Covers wide range of Tournapull applications, with action photographs and factual caption-type job descriptions. Projects covered range from general earthmoving, construction, mines, pits, quarries and railroads to applications in industrial, agricultural and oil fields.—*R. G. LeTourneau, Inc., Peoria, Ill.*

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